SECTION 26 05 00

ELECTRICAL CONTRACT REQUIREMENTS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.02 APPLICABLE PUBLICATIONS

A. Publications, standards and listing requirements called out in the Sections of this Division of Labor shall form a part of these specifications as if contained herein.

B. The requirements of the Contract Documents, including the General Conditions, and Supplementary Conditions, and Division 01 - General Requirements, apply to this section except as modified herein.

1.03 DESCRIPTION OF WORK

A. Sections Included:

1. Section 26 05 00 - ELECTRICAL CONTRACT REQUIREMENTS
2. Section 26 05 01 - PROJECT SPECIAL CONDITIONS
3. Section 26 05 04 - DOCUMENTATION
4. Section 26 05 05 - THROUGH-PENETRATION FIRESTOPPING
5. Section 26 05 19 - WIRE AND CABLE
6. Section 26 05 26 - GROUNDING
7. Section 26 05 29 - SUPPORTING DEVICES
8. Section 26 05 34 - RACEWAYS
9. Section 26 05 35 - ELECTRICAL BOXES
10. Section 26 05 37 - LOCATION OF OUTLETS AND EQUIPMENT
11. Section 26 05 53 - ELECTRICAL IDENTIFICATION
12. Section 26 09 23 - LIGHTING CONTROLS
13. Section 26 24 16 - PANELBOARDS
14. Section 26 27 02 - MOTOR WIRING
15. Section 26 27 26 - WIRING DEVICES
16. Section 26 27 28 - CIRCUIT AND MOTOR DISCONNECTS
17. Section 26 51 13 - INTERIOR LIGHT FIXTURES
18. Section 27 10 00 - STRUCTURED CABLING SYSTEM

B. Work Included:

1. The work covered by this Division of the specifications includes the furnishing of all labor, materials, tools, equipment, permits, certificates and temporary protection necessary for or incidental to executing and completing the electrical work, communications work, and work on related systems.
2. All work shall be as specified and indicated on the drawings unless specifically excepted on the drawings or herein.
3. Read all other Divisions of the Specifications which are applicable to this work, including the General Conditions section applicable to all bidders.
4. The Electrical Contract Requirements section is a supplement to and not a replacement for the project General Conditions section.
5. In cases of conflict with information in the General Conditions, the more stringent of the contract requirements shall be considered applicable.
6. Prior to submitting bid, call to the attention of the Electrical Engineer any material or apparatus believed to be inadequate or any necessary items or work omitted.
7. Address any questions regarding the interpretation of the plans and/or specifications at least 12 days before the bid opening.
8. The Electrical Engineer reserves the right to interpret his own specifications and plans after bids are received, and to demand that the installation conform to his intent.
9. Failure to become acquainted with existing conditions at the site shall in no way relieve the responsibility for making installation in conformance with plans and specifications without additional cost to the owner.

C. Examination of Plans, Specifications and Site:
1. Before submitting a bid, the bidder shall familiarize himself with all features of the building and site which may affect the execution of his work.
2. No extra payment will be allowed for the failure to obtain this information.
3. If there are omissions or errors in the plans or specifications, they shall be clarified with the architect prior to submitting bid.
4. For all remodeling projects, a site visit to the premises, for the purpose of the noting of all existing conditions which may affect work is required.
5. Knowledge of all existing conditions, which may affect work in a renovation project, shall be included in the preparation of bid.
6. Lack of information on existing conditions shall not be allowed for a valid cause for additional compensation.

D. Codes, Permits, and Inspection Fees:
1. All work and materials shall conform in every respect to the current rules and requirements of the National Fire Protection Association, National and State Electrical Codes, Local Codes and Ordinances, Local Utility Regulations and OSHA.

2. Give to the proper authorities all required notices relating to the project, obtain all official permits and licenses required, pay all fees incidental thereto, deliver upon completion of the work and without cost to the Owner all required certificates of inspection and approval.

1.04 RELATED WORK ELSEWHERE

A. Applicable provisions of Division 01: General Conditions shall govern work in this section.

B. All other Divisions of the Specifications which are applicable to or interface with work in Division 26 05 00.

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. Submit shop drawings following Section specific Shop drawing submittal guidelines.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit operation and maintenance manuals in accordance with Section 26 05 04.

B. Submit operation and maintenance manuals following Section specific shop drawing submittal guidelines.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

C. Acknowledges acquaintance with the plans and specifications and their respective requirements.

D. Guarantee that the electrical system has been installed strictly in accordance with the electrical plans and specifications using only the best of materials available, installed in a substantial manner by experienced labor.

E. Various components of the electrical system shall be placed in service prior to completion date as instructed by Owner. This shall not change the guarantee period which shall be one year after acceptance by Owner.

F. Replace and/or repair any items failing from causes of faulty workmanship, materials or design without cost to Owner at any time within one year from date of final acceptance.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 PRODUCTS

2.01 GENERAL

A. It is the intent of these specifications that all the necessary material, apparatus, and devices to complete the installation as specified herein, except such parts as are specifically excepted, shall be provided.

B. If an item is either shown on the plan or called for in these specifications, it shall be considered sufficient of said item in this contract.

C. All sizes given are as minimum.

D. Material and labor shall be first class and workmanlike and to the satisfaction of the Electrical Engineer and shall be subject to inspection test and approval at all times from commencement until acceptance of completed work.

E. Manufacturers shall be responsible for providing material listed by U.L. or other approved agencies, and all governing codes and ordinances.

F. All material must bear U.L. and/or other approved labels where possible.

G. Items specified by catalog number or brand name and approval of shop drawings will not relieve the manufacturer of this responsibility.

2.02 MATERIALS: ALTERNATE MATERIALS

A. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type of catalog number such designation is to establish standards of desired quality and style and shall be the basis of the bid.

B. Substitutions shall not be made unless there are "equals" listed in the specifications or on the plan.

C. Substitutions may be bid as alternates.

D. Burden of proof that materials are equal shall be upon bidder requesting their use; therefore, bidder shall furnish, with their request for approval all supporting data.

E. Assume responsibility for substituted material and state name of manufacturer, type or brand or equipment and addition to or deduction from base bid.

F. Materials and equipment must meet all requirements as to type, quality, function, appearance and physical dimensions shown.

G. Assume responsibility for any costs to other Divisions as a result of the use of alternate materials.

H. Submit supporting data to Architect/Electrical Engineer within 15 days after the bid date.

PART 3 EXECUTION

3.01 EXAMINATION

A. Equipment Submittal Drawings:
   1. Within 45 days after a notice to proceed and prior to ordering equipment, furnish to the Electrical Engineer submittal drawings for review (see section 26 05 04).
   2. Review of any submittal drawings does not waive any condition of the specifications unless specifically noted thereon.
   3. No fabrication or ordering of equipment shall be started until reviewed drawings are returned.

3.02 FIELD MEASUREMENTS

A. Job Drawings:
   1. Maintain, at the job site, one (1) complete set of up-to-date plans and written specifications, complete with all addenda items.
   2. This complete plan and specification set shall be reserved for all field markings to show minor revisions and detailed construction notes.
   3. These marked plans shall be returned to the Electrical Engineer prior to contract completion and final payment.
   4. Assist the Electrical Engineer in transferring applicable field notes to the project drawings for record purposes.

3.03 DELIVERY, STORAGE AND HANDLING

A. Material on Site and Storage:
   1. Maintain proper care and storage of material and equipment on site.
   2. Any material damaged by rust corrosion, warping, breakage, finish damage, etc. shall be replaced by the Contractor to the satisfaction of the Engineer.

3.04 INSTALLATION

A. Field Change Orders:
   1. No revisions to the contract price shall be allowed unless such revisions have been authorized in writing by both Owner and the change order submitter.

2. All work completed prior to completion of a written contract change order will not be compensated for by the Owner.
3. Any work item that is proposed to perform, on the basis of a proposed contract adder, must be announced in advance such that time is available for the Architect, Owner and the Electrical Engineer to determine if a change in contract price is allowable.

B. Change Orders:
1. Change orders may be requested as a part of this project.
2. Assume the following in regards to change orders:
   a. Work and equipment associated with change orders shall be installed per the specified equipment on this project.
   b. All change orders shall be accounted for on as-built drawings.
   c. Change order additions to special systems where riser diagrams have been furnished, shall be included as a part of the riser diagram.
   d. A break down of all costs associated with the change order is required.
   e. The cost breakdown shall be as follows:
      1) Itemized list of all materials.
      2) Materials shall be priced at Best Column in a national pricing service book.
      3) Cost for subcontractor services.
      4) Subcontractor services shall be shown as actual costs from subcontractor.
      5) Material mark-up.
      6) Maximum allowed is 8%.
      7) Number of hours of labor at standard charge out rate.
      8) Tax on material.
      9) Total change order cost.
3. If equipment or materials are deducted as a part of this change order, credit shall also be shown on change order.

C. Installation: General
1. Connections to Equipment Furnished by Others.
   a. Included in Division 26 are electrical connections to equipment provided by others.
   b. Refer to final shop drawings for equipment provided by other divisions for exact location of electrical outlets and the connections required.
   c. Provide energization to the equipment furnished by other Divisions only at the request of the providing party.
   d. Assume that once the equipment has been started up, that it shall be shut off unless it is requested that it be left on by the providing party.
   e. Only start up and turn on equipment if requested so by the party providing said equipment.

f. If required, power shall not be activated to the equipment until qualified starting personnel are on site.
g. After making a permanent power connection, the breaker shall be left in an off position and a "hold" tag or some other device be utilized to keep the power turned off to the equipment.

2. Equipment Access & Location.
   a. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance.
   b. Any relocation of conduits, equipment, or accessories required to provide maintenance access shall be accomplished at no additional cost.
   c. Equipment shall be installed with ample space allowed for removal, repair or changes to the equipment.
   d. Ready accessibility to equipment and wiring shall be provided without moving other equipment which is to be installed or which is already in place.
   e. Locate electrical outlets and equipment to fit the details, panels, decorating or finish at the space.
   f. The Architect shall reserve the right to make minor position changes up to 10' of the outlets before the work has been installed.
   g. Verify door swings before installing room lighting switch boxes and install boxes on the latch side of door unless noted otherwise.
   h. Furnish information as to exact location and size of sleeves for openings for new construction.
   i. Provide and set in place all required sleeves, inserts, forms, etc. and coordinate this work with all other divisions of work.

3. Cutting and patching.
   a. Beams or columns shall not be pierced without permission of the Architect and then only as directed.
   b. If any openings are required through walls or floors where no sleeve has been provided, the hole for the sleeve shall be core drilled to avoid all unnecessary damage and structural weakening.
   c. Provide all cutting and patching required for complete installation of systems unless specifically noted elsewhere.
   d. All new or existing work cut or damaged shall be patched and restored to its original condition.
   e. Coordinate the location of sleeves, openings, chases, furred spaces, etc.
   f. Provide during the progress of construction all sleeves, hangers and inserts that are to be built into the structure.
   g. Provide sleeves for cables passing through masonry, concrete or other similar construction.
   h. Sleeves shall be of metal conduit and shall extend completely through the construction.
   i. Conduits or cables penetrating smoke or fire barriers must not destroy the barrier's integrity.

j. Grout openings between sleeves and concrete or masonry walls and floors.
k. Pack annular space between sleeves and conduits with fiberglass.
l. Where penetrations occur through fire rated walls or floors, fill space with fire resistive caulk.
m. Wherever cables must pass through fire or smoke rated walls or floors, provide approved, sleeved, foam filled fire stops around cables as manufactured by O.Z., Dow, Square D, or equal.
n. Provide all materials required for patching unless otherwise noted.
o. Where alterations disturb lawns, paving, walks, etc., the surfaces shall be repaired, refinished and left in the condition existing prior to commencement of work.

4. Excavation and backfill.
   a. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area.
   b. Lines passing under foundation walls shall have a minimum of 1 1/2 inch clearance.
   c. Care shall be taken to insure no disturbance of bearing soil under foundations.
5. Attachments and supports.
   a. Be responsible for proper fittings and support for each item of equipment and materials installed under Division 26.
   b. Be responsible for the proper application, installation and location of all necessary and required inserts, supports and anchor bolts.
   c. Where same are to be installed by other Divisions of work, supply same to the contractor in whose work they occur with instructions for placement and proper installation.
   d. Establish the method and nature and select accessories necessary for proper support appropriate to item and point of attachment with due consideration given to ambient/environmental conditions and service duty.
   e. Attachments, supporting devices and accessories shall be specifically designed for the application, suitable for the duty imposed in service and acceptable to the Architect.
   f. Attachments shall be made to structural components of the structure in such manner not to jeopardize the integrity of the structure and otherwise consistent with trade practices.
   g. Generally, anchors shall be concrete insert type in poured concrete and drilled expansion type in precast concrete.
   h. Powder actuated anchors shall not be used in concrete work.
   i. Provide all mounting backboards as required to mount electrical and electronic equipment.
   j. That equipment which is normally assumed to be mounted on some type of a backboard shall be mounted on backboards provided by Division 26.

k. All mounting backboards used by the contractor shall be 3/4" AC grade marine duty plywood.
l. All plywood shall be painted on both sides and edges with two coats of fire resistant gray enamel paint.
m. Provide back mounting panels to meet this specification.
n. Steel channel interior to be painted or galvanized.
o. Exterior conduit mounting channel shall be stainless steel.
p. All sleeves to be furnished and installed by Division 26.

D. Installation: Temporary Electric Distribution
1. Extend the temporary electric distribution from the owner's existing electrical system.
2. Installation of the temporary power and lighting system is to begin upon notification by the Architect and shall be installed and routed in manner acceptable to the Architect and the various trades so as not to interfere with construction of the project.
3. The temporary power and lighting system should be adequate for the construction of this project and in accord with OSHA Requirements for Construction Projects.
4. Provide a minimum of 20 foot candles of lighting in work areas for construction.
5. The temporary light and power system shall include fused main disconnect switch, panelboards, branch circuits, outlets, lamps and the maintenance thereof.
6. Temporary lights shall be equipped with heavy duty electric cords and guards.
7. Temporary lights must not be suspended by the power supply cord unless it is designed for this use.
8. Furnish 2 general purpose, 20 ampere, 120 volt, single phase, grounding type receptacle outlets for every 1000 square feet of floor space.
9. The maximum length of a 20 ampere, 120 volt lighting or power circuit shall not be greater than 200' from panelboard to farthest outlet.
10. All single phase receptacle outlet circuits shall have approved ground fault circuit interrupter protection or other OSHA approved protection systems.
11. For work with existing electric service, see spec section 26 05 02, Demolition.
12. Temporary power requirements, other than the specified, shall be furnished by the division of work requiring the same.

E. Installation: Trial Usage of Electrical Systems
1. The Electrical Engineer has the privilege of the trial usage of electrical systems or parts thereof for the purpose of testing under load the new installation and learning the operational procedures.
2. The trial usage shall be continued for a length of time as deemed reasonable by the Electrical Engineer and all related costs shall be included in the bid, with the exception of the electrical power cost which will be paid by the Owner.

3. The operations shall be carried out only with the express knowledge and under supervision of the responsible sub-trade who shall not waive any responsibility because of trial usage.
4. While trial usage will be kept to a minimum, it shall not be construed as acceptance by the Electrical Engineer.

F. Installation: Cooperation/Coordination
1. Coordinate and cooperate with other Divisions of work and Owner by scheduling and installing work to facilitate the construction progresses and the Owners use of the building.
2. Any deviation from contract plans shall be approved by the Electrical Engineer before proceeding.
3. Study the plans of other trade divisions of work and to fit work into the work of others in a coordinated manner.
4. Lay out work and be responsible for measurements.
5. Check facilities provided by others which require electrical connections and provide outlets suitably located for them.
6. Take such measurements as may be necessary to assure approved fitting and proper installation of his work and all other work depending thereon.
7. Cooperate with other contractors to avoid complications between the installation of electrical equipment and equipment installed by others.

G. Installation: Finish and Painting
1. Equipment and materials such as transformers, panels and switches, shall be furnished with the manufacturer's standard finishes, consisting of a prime coat and baked enamel finish coat, unless otherwise noted.
2. Roof mounted equipment and other exterior materials including support hardware shall have a factory or field applied prime coat and finish coat of color selected by the Owner's Representative.
3. In general painting will be done by other trades. Assume responsibility to coordinate work with the painters so that all equipment is installed prior to painting.
4. Assume responsibility for additional expense required to paint support channels, panel trims, flush junction box covers, fixture hangers and other electrical devices not in place prior to normal routine painting.
5. An undamaged finish is required on all equipment.
6. If finish becomes rusted, corroded, scratched, or flaked during storage or installation, be responsible for refinishing the equipment to the satisfaction of the Architect.
7. Finish painting on the job site is not required by the electrical contractor, except where noted.
8. Refer to other areas of this Division 26 for painting of equipment furnished by the Division 26.
9. Where painting is required to be done by the electrical contractor, the painting shall be done in accordance with the painting portion of the general specification.

H. Installation: Damage to Other Work
1. Assume responsibility for all damages resulting from the execution of work under Section 26 05 00.
2. Assume responsibility to adequately protect Division 26 work at all times.
3. All damages resulting from their operations shall be repaired, or the damaged portions replaced by the party originally performing the work (to the entire satisfaction of the Architect), and all cost thereof shall be borne by those responsible for the damage.

I. Installation: Clean-Up
1. At all times, keep the premises free from excessive accumulation of waste materials or rubbish resulting from work, including tools, scaffolding, and surplus materials and leave work room or it's equivalent, clean.
2. In case of dispute, the Architect may order the removal of such rubbish and charge the cost to the responsible Division of work as determined by the Architect.
3. At the time of final clean-up, all fixtures and equipment shall be thoroughly cleaned and left in proper conditions for their intended use.

J. Installation: Drawing Schedules and Details
1. The electrical drawings include a number of standard and job specific details.
2. These details may or may not be specifically referenced on the drawings and in the specification.
3. Assume that even if the detail is not specifically referenced, that it shall apply to this project. (As an example, if a detail is shown for the exterior mounted receptacles, but the detail is not referenced from the plan sheets, the contractor shall assume that all exterior mounted receptacles shall be installed per the detail.)
4. Details and schedules are shown as a means to aid the electrical contractor and are not meant to be all inclusive of all devices.
5. Assume responsibility for making takeoff of equipment required, (i.e., additional circuit breakers, motor connections, etc.) and ancillary equipment and appurtenances for a complete connection or circuit.
6. Verify all sizes of electrical equipment with shop drawings and nameplate rating of the equipment it serves.

K. Installation: Coordination Drawings
1. Prepare coordination drawings to a scale of ¼” = 1’0 or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components.
2. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including, (but not limited to) the following:
3. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
b. Exterior wall and foundation penetrations.
c. Fire-rated wall and floor penetrations.
d. Equipment connections and support details.
e. Sizes and location of required concrete pads and bases.

4. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
5. Locations include, but are not limited to, electrical rooms and other specialty electrical and communication rooms where equipment is being provided.

L. Installation: Bid Drawings

1. It must be understood that electrical drawings and details bid drawings are diagrammatic.
2. Electrical drawings and details bid drawings are not intended to be shop drawings.
3. It is expected that it may be necessary to move conduit, outlets and/or equipment in some cases to get coordinated installation and such changes are considered a part of the Contract obligation without cost to the Owner.
4. No outlets or equipment shall be located where the usefulness and/or operation will be affected by the work of other trades, door swing, counter, equipment, etc.

M. Installation: Contract Termination Requirements

1. Furnish Owner with service manuals for all items furnished under this Contract.
2. Service manuals shall be complete with drawings, diagrams, operations and installation instructions and parts lists.

3.05 OWNER TRAINING

A. Provide as outlined per section.

3.06 SPARE EQUIPMENT

A. Provide as outlined per section.

END OF SECTION

SECTION 26 05 01

PROJECT SPECIAL CONDITIONS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. This specification covers those conditions that are particular to this project. This section further explains and outlines other portions of these specifications.

PART 2 PRODUCTS

2.01 DOOR ACCESS SYSTEM

A. Door Access System Installer/Provider

1. Toepfer Security Corporation
   ATTN: Mike Zubarik
   Senior Account Executive
   2215 Corporate Drive
   Waukesha, WI 53189
   Office: 262-650-7233
   Cell: 414-788-9972
   Email: MZubarik@toepfersecurity.com

2. EC to contact Toepher Security Corporation to include in his bid all work associated with adding the door access devices to the existing system as shown in the drawings.

B. USDD General Communications (Radio Speakers) Installer/Provider

1. USDD General Communications
   ATTN: Todd Petterson
   Cell: 680-219-6257
   Email: Todd.Petterson@gencomm.com

2. Electrical contractor shall work with USDD General Communications regarding the alterations/additions for the radio speaker system devices as shown on the drawings.

C. AVI System Installer/Provider

1. AVI Systems
   ATTN: Terry Toraason
   Executive Account Manager
   W6483 Design Drive, Suite B
   Greenville, WI 54942
   Office: 920-445-8127
   Cell: 920-203-9453
   Email: terry.toraason@avisystems.com

2. Electrical contractor shall work with AVI regarding the relocation of existing devices as shown on the drawings.

2.02 TELEPHONE PAGING SYSTEM

A. Extend the existing telephone paging speakers into the new and remodeled areas as shown on the drawings.

B. Provide the new ceiling speakers as shown on the drawings. Provide additional amplifiers as necessary to power these new speakers.

C. All necessary equipment required to meet the intent of these specifications, whether or not listed within these specifications, shall be supplied and installed to provide a complete and operational system.

D. Intercom Field Hardware

1. Loudspeakers shall be eight inch seamless cone type. The ceramic magnet shall weigh at least 4.8 ounces. The frequency range shall be from 90 to 15,000 Hz. The normal wattage rating shall be 8 watts with a program rating of 12 watts. The voice coil diameter shall be 3/4" and the impedance 8 ohms. The loudspeaker shall be equipped with a universal matching transformer suitable for use on a 25-volt output line with taps at 1/2, 1, 2 or 4 watts.
    a. Ceiling speakers (flush mounted) shall be mounted in a Soundolier T198-8 backbox with a T620-8 baffle.

E. WIRE AND CABLE

1. The speaker cable shall be a UL listed 20 AWG stranded copper conductor with plenum rated insulation, plenum rated. Each cable shall have 2 twisted conductors shielded with an aluminum mylar tape shielded material and have a 22 AWG tinned drain wire. Each cable shall also have 1 conductor not shielded.

2.03 MONUMENTAL SIGN POWER

A. Relocate existing power connection for the exterior sign to make way for the new building addition as shown on the drawings.

2.04 EQUIPMENT FURNISHED BY OWNER FOR DIVISION 26 INSTALLATION

A. Be responsible for installation of all equipment that is being furnished directly by the Owner. Include costs in bid to move the equipment from the owner’s storage to the project site, unpack the equipment, inspect the equipment for damage and call to the Owners attention any problems, dispose of packaging materials, and provide all connection and adjustment.

2.05 WIRING OF HANDICAP ACCESSIBLE MOTORIZED DOORS

A. The handicap door operators will be furnished by other contractors. Provide wiring to the door operator. Work will consist of the following:
   1. Verify voltage and phase with door supplier prior to rough-in.
   2. Determine type of connection to doors.
   3. Wire any limit switches or other controls associated with the door.
   4. Interconnect with keyless entry system to allow door to operate only if inside push paddle is activated. If door is in locked position with electric strike and paddle is activated from exterior the door will not open.
   5. Electrical contractor shall review the specifications to determine exact requirements.

2.06 MULTI-POLE CIRCUITS

A. Multi-pole circuits are not allowed for single-phase line to neutral loads.

PART 3 EXECUTION

3.01 ALLOWANCES (NONE)

3.02 ALTERNATES (NONE)

END OF SECTION

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SECTION 26 05 04

DOCUMENTATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 SYSTEM PRE-INSTALLATION INFORMATION

A. Provide system pre-installation information for all equipment indicated on the Project Documentation Submittal List. Information shall include:
   1. System wiring diagrams.
      a. System wiring diagrams for the systems listed below shall be provided as a complete riser diagram. This riser diagram shall include all components of the system, as well as a designation adjacent to each component indicating the room or space in which it is located. Cable type used shall also be identified. This designation shall be by description of space or by room number.
         1) Spec section 27 10 00 – structured cabling system.
   2. Diagram format.
      a. All riser diagrams shall be done in the following manner:
         1) CAD drawings.
         2) All symbols used shall be the same symbols are used on the electrical contract documents.
      b. Each component of the built-up system must have the following information provided:
         1) Each component must be indicated on a riser diagram and shown how it interconnects to other parts of the system.
         2) Provide front elevation of rack or enclosure for system.
         3) Size of enclosure shall be indicated.
         4) Spacing or special mounting requirements shall be indicated.
         5) Signal candela level.

DATA CABLE LISTING PROJECT_____

LISTED BY PATCH PANEL JACK

Rack location	Rack Number	Patchpanel Number	Patchpanel Jack Number.	Cable Number	Room Number	Room Jack Number

MSA Professional Services, Inc.
116 FREMONT STREET
KIEL, WI 53042

DATE MADE_____

PAGE _____ OF _____

(920) 894-7800

B. System installation information shall be updated to reflect the installed system. This updated information shall be included as a part of the final O&M manual.

C. Drawings shall be supplied for each existing building system that is revised or added to. The drawings do not have to show all existing building equipment, only those items where the new system is extended from. A brief description should be given of the existing system and how it was extended.

D. Record drawings shall be reduced to 11" X 17" or 8 1/2" x 11" and included with the equipment drawings in the final O&M manual. See O&M MANUAL Description in this specification section.

1.03 FINAL TESTS AND DEMONSTRATIONS

A. Test all work and all equipment installed to ensure its proper and safe operation. Check all interlocking and automatic control sequences and test the operation of all safety and protective devices. Rectify all defects. Coordinate this work with the Power Company, supplier's representative and all other persons as directed by the OWNER or his representatives, in order to achieve the proper and intended operation of all equipment.

B. Test, adjust and record operating voltages at each system level before energizing branch circuits. Transformer taps must be adjusted to obtain as near as possible nominal system voltage. Where transformer is under Utility jurisdiction, obtain services of Utility to correct voltage. Be responsible for replacement of all devices and equipment damaged due to failure to comply with this requirement.

C. Balance load among feeder conductors at each panelboard and reconnect loads as may be necessary to obtain a reasonable balance of load on each phase. Electrical unbalance shall not exceed 10%.

D. Provide all instruments and equipment necessary to perform required tests.

E. All checks and tests shall be permanently recorded and made available to the OWNER or his representatives. The tests shall include:
   1. System grounding.
   2. Fuses:
      a. Equipment nameplate requirement
      b. Actual fuse rating
   3. Breakers:
      a. Nameplate
      b. Actual rating
   4. Motors:
      a. Complete nameplate data
      b. Overload relay element

c. Voltage and current phase readings
d. Direction of rotation

5. Ampere readings on any cable operating in parallel to insure an even division of current.

F. The above reading shall be made for all fuses, breakers, motors and parallel cables installed as part of this contract and connected to by Division 26. This testing shall be for all new equipment, whether furnished by the electrical contractor or not.

G. Upon request, demonstrate proper operation of all electrical systems and equipment in the presence of the Architect's Consulting Electrical Engineer and/or other designated persons.

1.04 PROJECT CLOSEOUT CHECKLIST

A. Submit the following:

ITEM	SUPPLIED TO:	CHECK OFF
Accounting of all additional items as detailed in spec section 26 05 01.	ARCHITECT	_____
Structured Wiring Documentation (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Tabulations (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Reduced Floorplans (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Data Warranty (SPEC 27 10 00)	ARCHITECT	_____
Data Cable Installation Warranty (SPEC 27 10 00)	ARCHITECT	_____
Letter stating all specified spare equipment was delivered to owner. The letter should list the equipment supplied.	ARCHITECT	_____
O&M Manual	ARCHITECT	_____

Certificate from systems suppliers stating that the system was started up, tested and Owner's instructions were given. Certificate shall have date of instructions and test and shall have the owner's representative's signature.	ARCHITECT	_____
Copy of marked up record drawing.	ARCHITECT	_____
Provide warranty for all equipment.	ARCHITECT	_____

END OF SECTION

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SECTION 26 05 05

THROUGH-PENETRATION FIRESTOPPING

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 APPLICABLE PUBLICATIONS

A. Fire Test Requirements:
   1. ASTM E-814, “Fire Tests of Through Penetration Fire Stops”.
   2. ANSI/ UL1479, “Fire Tests of Through Penetration Fire Stops”
   3. ASTM E-119, “Fire Tests of Building Construction and Materials”.
   4. ANSI/ UL263, “Fire Tests of Building Construction and Materials”.
   5. ASTM E-84, “Surface Burning Characteristics of Building Materials”.
   6. ANSI/ UL723, “Surface Burning Characteristics of Building Materials”.

B. References:
   1. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.
      a. Through Penetration Firestop Systems (XHEZ)
      b. Fill, Void or Cavity Materials (XHHW)
      c. Firestop Devices (XHJI)
      d. Forming Materials (XHKU)
   2. All major building codes:
      a. Uniform Building Code published by ICBO
      b. Standard Building Code published by SBCCI.
      c. National Building Code published by BOCA.
      d. International Building Code published by ICC.
   3. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.
   4. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 70: National Electrical Code”.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete firestopping installation as specified herein.

B. This section includes through-penetration firestop systems for electrical equipment and penetrations through the following fire-resistance rated assemblies, including both blank openings and openings containing penetrating items such as conduits, cabling, cable trays and bus duct:
   1. Floor-ceiling assemblies.

2. Roof-ceiling assemblies.
3. Walls and partitions.
4. Smoke barriers.
5. Construction enclosing compartmentalized areas.

C. This includes both existing installations to remain and new installations.

D. Patch walls at any removed installations to maintain rating of wall.

1.04 RELATED WORK ELSEWHERE

A. Division 26 and 27 – Electrical

1.05 SHOP DRAWINGS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Product Certificates: Certificate of conformance signed by manufacturers of through-penetration firestop system products certifying that products comply with requirements.

1.06 OPERATION & MAINTENANCE MANUALS (NONE)

1.07 QUALITY ASSURANCE

A. Provide through-penetration firestop systems that comply with the following requirements :
   1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
   2. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
   3. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

B. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.

C. Through-penetration firestop systems shall be subjected to necessary inspections and tests.

D. Keep areas of work accessible until inspection by authorities having jurisdiction.

E. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 FIRESTOPPING, GENERAL

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Performance Requirements:
   1. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
   2. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofit.

2.02 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
   1. Manufacturers listed in the UL Fire Resistance Directory – Volume 2.

2.03 MATERIALS

A. General: Use only through-penetration firestop system products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item.

D. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.

E. Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and nonmetallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 24”.

F. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film.

G. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag.

H. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.

I. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag).

J. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.03 DELIVERY STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multicomponent materials.

E. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

3.04 INSTALLATION

A. General Requirements: Install through-penetration firestop systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems products.
   1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
   2. Protect materials from damage on surfaces subjected to traffic.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

D. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

E. Project conditions:
   1. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limitations recommended by manufacturer.
   2. Do not install through-penetration firestop systems when substrates are wet due to rain, frost, condensation, or other causes.
   3. Do not use materials that contain flammable solvents.

4. Do not install water-based or products that are conductive when wet in contact with energized electrical conductors. Exercise care when energizing penetrants.

F. Coordination:
1. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
2. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
3. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

G. Preparation:
1. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
2. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
3. Do not proceed until unsatisfactory conditions have been corrected.

END OF SECTION

SECTION 26 05 19

WIRE AND CABLE

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
   1. NFPA 70 – National Electrical Code.
   2. ANSI/TIA/EIA-568-B.2.

B. National Electrical Contractors Association (NECA), Standard of Installation, current edition.

C. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.

D. Underwriters Laboratories, Inc. (UL).

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete and operable wire and cable system as indicated on the drawings and as specified herein.

1.04 RELATED WORK ELSEWHERE

A. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the items listed above:
   1. Manufacturer literature in scope to demonstrate compliance with the requirements of this specification.
   2. Clearly identify the types of wire and cable proposed.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. Wire and cable manufacturers shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development and production in accordance with ISO 9001.

C. All materials, equipment, and parts shall be new and unused of current manufacture.

D. Provide all necessary accessories required for a complete and operable system.

1.08 WARRANTY

A. Wire and cable shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. Approved manufacturer:
   1. Contractor's option.

B. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 WIRE AND CABLE – GENERAL PURPOSE (600V)

A. General:
   1. All conductors with ampacity of 100A or less shall be copper. Aluminum conductors are allowed for feeders with ampacity greater than 100A with exception of conductors feeding HVAC motors, HVAC equipment, generators, transfer switches and elevator. Feeders for this equipment must be copper.
   2. THWN or THHN general purpose building wire insulated with polyvinyl chloride (PVC) and covered with protective sheath of nylon intended for lighting and power circuits at 600 volts or less, in residential, commercial, and industrial buildings.

3. The wire shall be suitable for 90ºC maximum continuous conductor temperature in dry locations and 75ºC in wet locations and listed by Underwriters Laboratories for use in accordance with Article 310 of the National Electrical Code.

B. Conductors:
1. Class B or Class C stranded, annealed uncoated copper per UL Standard 83 or 1063.
2. Where aluminum conductors are allowed, aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).

C. Insulation:
1. Each conductor shall be insulated with PVC and sheathed with nylon complying with the requirements of UL Standard 83 for Types THHN or THWN and UL Standard 1063 for Type MTW and CSA C22.2 No. 75 for T90 Nylon.
2. Types THWN or THHN shall comply with the optional Gasoline and Oil Resistance rating of UL Standard 83. The insulation shall also comply with UL requirements for 105ºC Appliance Wiring Material.
3. The average thickness of PVC insulation, for a given conductor size, shall be as specified in UL Standard 83 for TWHN or THHN. The minimum thickness at any point, of the PVC insulation, shall be not less than 90 percent of the specified average thickness.
4. The minimum thickness at any point of the nylon sheath shall be as specified in UL Standard 83 for Types THWN or THHN.
5. Where aluminum feeders are allowed, insulation to meet requirements of XHHW-2 Standards.
6. The PVC insulation shall be applied tightly to the conductor and shall be free-stripping.

D. Identification:
1. The wire shall be identified by surface marking indicating manufacturer's identification, conductor size and metal, voltage rating, UL Symbol, type designations, and optional ratings. The wire shall also be identified as C (UL) Type T90 Nylon or TWN 75, FT1.

E. Tests:
1. Wire shall be tested in accordance with the requirements of UL Standard 83 for Types THWN or THHN wire and for the optional Gasoline and Oil Resistance listing; as Type MTW to UL Standard 1063 (stranded items): as AWM to UL Standard 758 (stranded items); and as C(UL) Type T90 Nylon or TWN75.

F. Usage:
1. General use power wiring, minimum size No. 12 AWG.

2. General use control wiring, minimum size No. 14 AWG.

2.03 WIRING CONNECTORS

A. Polaris Type Mechanical Connectors:
   1. 8 AWG and larger wire for all motor connections.

B. Spring Wire Connectors:
   1. 10 AWG and smaller wire.

C. Compression Connectors (T&B Sta-Kon or equal):
   1. Fire alarm wiring.
   2. Control wiring.
   3. For those devices that are not rated to accept stranded wire.

D. Cord Connectors. All cord connectors should be Kellums type using wire mesh cord restraint.

E. Provide watertight Crouse-Hinds or equal cord grips in appropriate areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wire is in compliance with specifications.

B. Verify that interior of building has been protected from weather.

C. Verify that mechanical work likely to damage wire and cable has been completed.

D. Inspect wire for physical damage and proper connection.

E. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

F. Verify continuity of each conductor.

G. Feeder or branch circuits with ampacity greater than 100 amperes shall be tested after installation to measure insulation resistance of each conductor.
   1. All equipment shall be disconnected and the wire ends shall be cleaned and dried.
   2. Connect Megohmeter between conductor and a grounded point in the enclosure and energize until the reading stabilizes.
   3. The Megohmeter reading for each conductor shall not be less than 10,000 Megohoms.

3.02 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of wire while it is in storage.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Pre-Installation:
   1. Verify that interior of building has been protected from weather.
   2. Verify that mechanical work likely to damage wire has been completed.
   3. Completely and thoroughly swab raceway prior to installation.
   4. Verify that field measurements are as shown on drawings.
   5. Wire and cable routing shown on drawings is approximate unless dimensioned. Route wire and cable to satisfy project conditions.
   6. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
   7. Determine required separation between cable and other work.
   8. Determine cable routing to avoid interference with other work.

C. Conductor Sizing:
   1. Conductor sizes are based on copper.
   2. Use conductor not smaller than No.12 AWG for power and lighting circuits.
   3. Use No.10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 75 feet.
   4. Use No. 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 200 feet.
   5. Where circuit wiring length exceeds 100 feet, increase wire size as needed to maintain a maximum voltage drop of three percent.
   6. Use conductor not smaller than No.14 AWG for control circuits.
   7. Wire and cable size shall be increased from size indicated or required by code to meet the following voltage drop requirements:
      a. 3% drop for branch circuits.
      b. 5% drop for motor circuits.

D. Wire Pulling:
1. Pull all conductors into raceway at same time.
2. No.4 AWG and larger wire and power cables shall be lubricated with pulling lubricant to reduce pulling tension and abrasion damage. The lubricant shall be water or wax based containing no oils or greases that may adversely affect cable jackets.
3. The minimum bend radius and maximum pulling tension ratings of the wire and cable shall not be exceeded.

E. Splices and Terminations:
1. Splices and terminations shall not be made within raceways.
2. Clean conductor surfaces before splicing or terminating.
3. Make splices, taps, and terminations to carry full amp capacity of conductors with no perceptible temperature rise.
4. Wire nuts, “ScotchLocks”, and similar devices may be used to splice 120V power circuits.
5. Control, communication, and data transmission wire and cable shall not be spliced.
6. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels or support for the ceiling suspension system per NEC.
7. Neatly train and lace wiring inside boxes, equipment, and panelboards.
8. Clean conductor surfaces before installing lugs and connectors.
9. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
10. All aluminum conductors shall terminate on tin plated, aluminum-bodied compressor lug or compression adapter. An oxide-inhibiting joint compound must be applied on the aluminum conductor during termination. The compression connectors shall be installed according to manufacturers’ instructions with the compression tool recommended by the manufacturer of the connector.
11. Perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor.
12. Use polaris type mechanical connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
13. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Motors:
1. Motor wiring to motors less than 10 horsepower shall be spliced and terminated with fully insulated crimp-on end cap with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl electrical tape. “SkotchLocks” and similar devices shall not be used.

2. Motor wiring to motors 10 horsepower or larger shall be spliced and terminated with crimp-on ring terminal lugs, brass nuts, bolts and washers with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl electrical tape. "SkotchLocks" and similar devices shall not be used.

G. Wire Marking:
1. The ends of each conductor shall be marked with circuit number, motor number, wire or terminal number.
2. Labels shall be typed in black lettering with indelible ribbons on a white, heat shrink sleeve. Markers shall be shrunk around the wire to provide a tight, non-slip bond with a compatible heat gun.
3. Heat shrink wire markers shall be Brady Bradysleeve Type B-321 or B-322

H. Color Coding:
1. Color coding shall be as follows:

	120/208V System
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

I. Ground Wire Color Coding
1. Provide green insulated ground wire for #8 and smaller. #6 wire shall have green band per code.

J. Control Panels
1. Control panel wiring. Wiring within control cabinets shall be stranded type MTW.

K. Shared Neutrals
1. All branch circuits shall have its own neutral.

END OF SECTION

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SECTION 26 05 26

GROUNDING

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to current Telecommunication Industry Association (TIA/EIA).

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

E. Product specific standards and requirements are included in product specifications.

F. EIA/TIA-607.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete and operable grounding and bonding system as indicated on drawings and specified herein.

B. Ground and bond all equipment required per all applicable codes whether or not specifically shown on drawings.

C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

1.04 RELATED WORK ELSEWHERE

A. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS (NONE)

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

1.08 WARRANTY

A. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. Submit a written warranty executed by the installer indicating ground test was completed.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Provide a complete and fully functional grounding system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions. Provide all accessories necessary for a fully functioning system.

2.02 GROUND RODS

A. Material: Copper-clad steel.

B. Diameter: 3/4" minimum.

C. Length: 10' minimum. Rod shall be driven at least 9'5"deep.

D. Use one or more ground rods to obtain the minimum specified ground resistance. This applies to manholes, padmount switches, transformers, service entrances, and all other equipment requiring a supplemental grounding electrode. Minimum of three ground rods shall be used to ground the service entrance as indicated on plans.

2.03 MECHANICAL CONNECTORS

A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers, and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two bolt type.

B. Split bolt connector types are not allowed.

C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.04 COMPRESSION CONNECTORS

A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99 percent.

B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size, and the required compression tool settings.

E. Each connector shall be factory filled with an oxide-inhibiting compound.

2.05 EXOTHERMIC CONNECTIONS

A. Select the appropriate kit for specific types, sizes, and combinations of conductors and other items to be connected. Field personnel shall be trained in execution of welds.

2.06 WIRE

A. Material: Stranded copper (aluminum permitted only with aluminum conductors).

B. Grounding Electrode Conductor: Size as shown on drawings, specifications, or required by NFPA 70, whichever is larger.

C. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, in specifications, or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

3.02 FIELD MEASUREMENTS

A. Field verify exact routing of all backbone cable.

B. Adjust grounding system installation to satisfy field requirements.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

3.04 INSTALLATION

A. General:
   1. Provide a separate, insulated equipment grounding conductor in all raceways.
   2. Connect grounding electrode conductors to metal water pipe:
      a. Use a suitable ground clamp.
      b. Make connections to flanged piping at street side of flange.
      c. Provide bonding jumper around water meter.
   3. Supplementary Grounding Electrode:
      a. Use driven ground rod on exterior of building.
      b. Install ground rod in suitable recessed well; fill with gravel after connection is made.
      c. Effectively ground metal frame of the building.
      d. Install grounding conductor to footing rebar per NEC.
   4. Provide ground wire in all surface metal raceways, and wireways.
   5. Receptacle grounding:
      a. For all receptacle circuits, provide separate green ground wire in raceway system.
      b. Standard receptacles may be used and green wire shall be directly connected to receptacle or to pigtail.
      c. Provide #12 pigtail to ground all metal boxes.
      d. Stranded wire twisted on ground terminal on device is not allowed.

B. Ground Rod Installation:
   1. Install ground rods to be 10’6” deep.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current American National Standards Institute (ANSI) standards.

C. Conform to current American National Standards Institute ANSI B31.1 standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”

1.03 DESCRIPTION OF WORK

A. Furnish and install complete and operable support devices as required.

B. Metal supporting devices shall be zinc galvanized or cadmium plated steel or malleable iron.

C. Equipment and materials shall be supported with devices designed for such purpose. Wire or plastic ty-raps not acceptable.

D. Where so specified on the drawings, provide stainless steel, PVC covered, or hot dipped galvanized.

E. Refer to drawings or other portions of the specifications for particular pieces of equipment which may require more stringent equipment specifications than listed in this specification.

1.04 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS (NONE)

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 LIGHTING FIXTURE SUPPORT

A. Provide items such as stems, hickeys, bar hangers, and clips required to securely attach fixtures to ceilings or walls.

B. Provide troffer arms for supports, lay-in troffers for exposed grid ceiling and grid troffer support clips in accordance with NEC and manufacturer's recommendations.

C. Provide and install channel supports across main grid runners or grid supports, securely tied down or anchored for fixtures and devices mounted in suspended ceiling systems not causing tile to sag and so fixture or device cannot be lifted, rotated or displaced.

D. Provide spacers or stabilizers to eliminate fixture instability.

E. Drilled expansion insert type anchors suitable for load and application requirements such as sleeve anchors, lag shields, and plastic anchors.

F. Provide auxiliary supports so fixtures can be drawn up tightly, tilted or rotated, and not affected by vibrations.

2.03 SUPPORTING STRUCTURES

A. Rack supports of galvanized steel channel sections with adequate feet to allow secure mounting. Weld sections, do not use bolts.

2.04 MOUNTING EQUIPMENT

A. For all panelboard, starters, disconnects, control panel, etc. provide mounting panels of not less than 1/4 in. steel plate or 3/4 in. exterior grade plywood. Provide uniform mounting panels as far as practical. Paint plywood panels with 2 coats of fire rated gray enamel paint on all sides and ends.

2.05 CONDUIT SUPPORTS

A. 1- hole galvanized steel straps for EMT, 2-hole galvanized steel straps for all other conduits. Do not use perforated hanger iron.

2.06 VERTICAL CABLE SUPPORT

A. Support conductors in vertical raceways using suitable cable supports. Locate supports so each 25 ft-0 in. length of conductor in vertical raceway will be complete with support.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify locations prior to rough in.

B. Verify mounting details

3.02 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, or other conduit.

D. Do not use spring steel clips on ceiling support wires.

E. Do not use powder actuated anchors.

F. Obtain permission from Architect before drilling or cutting structural members.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present a neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

J. Use steel metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

K. Degrease and clean surfaces to receive nameplates and labels.

L. Install nameplate and label parallel to equipment lines.

M. Secure nameplates to equipment fronts using screws if so specified on drawings.

N. Anchors:
   1. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and transfer of loading and stresses to connected equipment.
   2. Installation methods shall be in conformity with manufacturer's recommendations for maximum holding power.

O. Conduit Supports:
   1. Support conduit as follows:
      a. Vertical Surfaces: Galvanized, heavy-duty, sheet steel straps; back straps provided for exposed conduit and conduit on exterior walls.

b. Horizontal Surfaces: Single or double rack channel trapeze, complete with conduit straps as required; supported with threaded hanger rods.

2. Support 1 3/4 in. and larger conduit runs passing through floors at each floor with riser pipe clamps.

P. Conduit Extending Through Roof:

1. Conduit extending through roof shall pass through ceiling box at roof line.
2. Provide 14 ga minimum galvanized 12 gauge box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit or provide a neoprene boot as compatible with roof.
3. Install conduit and pitch pocket in advance of roofing work.
4. Coordinate with roofer for providing all appurtenances required so that the installed system complies with roofing installation.

END OF SECTION

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SECTION 26 05 34

RACEWAYS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to current Telecommunication Industry Association (TIA/EIA).

E. Conform to current American National Standards Institute (ANSI) standards.

F. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

G. Product specific standards and requirements are included in Product Specifications.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete and operable conduit/raceway system as indicated on the drawings and as specified herein.

B. All wire shall be in conduit or surface raceway. All conduit in finished areas shall be concealed. In unfinished areas, such as utility and mechanical rooms, the contractor shall conceal the branch wiring such as receptacles and light switches.

C. Where conduit passes through areas of differing temperatures, such as into or out of cool-rooms, freezers, unheated and heated spaces, buildings, provide listed conduit seals to prevent the passage of moisture and water vapor through the conduit.

D. Materials Included:
   1. Metal conduit.
   2. Flexible metal conduit.
   3. Liquidtight flexible metal conduit.
   4. Electrical metallic tubing.

5. Nonmetallic conduit.
6. Surface metal raceways.
7. Wireways.

1.04 RELATED WORK ELSEWHERE

A. Division 03: Concrete

B. Division 04: Masonry

C. Division 09: Finishes

D. Division 12: Furnishing

E. Division 23: Heating, Ventilation and Air Conditioning

F. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 CONDUIT GENERAL REQUIREMENTS

A. Minimum Size: 1/2 inch.

B. Conduit types not listed below are prohibited.

C. Rigid heavy wall galvanized steel conduits:
   1. Are to be used in the following locations:
      a. Outdoors.
      b. Underground, unless PVC is shown on drawings or called out in other portions of this specification.
      c. In and under ALL concrete slabs, except for where PVC is allowed as stated in nonmetallic conduit portion of this specification.
      d. In areas having moisture, dust or gases.
      e. Exposed conditions where such mechanical protection is required.
   2. Manufacturer: CONTRACTOR option.
   3. Conduit:
      a. Impact and crush resistant mild steel tube with an accurate circular cross section, a uniform wall thickness, a defect free interior surface, and a continuous welded seam.
      b. Interior and exterior surfaces thoroughly and evenly coated with zinc using the hot-dip galvanizing process.
      c. Top-coated with a compatible organic layer to inhibit white rust and increase corrosion resistance.
      d. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an application of molten zinc.
   4. Conduit Bodies:
      a. Ferrous metal construction electro-galvanized inside and out and coated with aluminum acrylic paint.
      b. Tapered, threaded hubs with integral bushing.
      c. Stainless steel hardware.
      d. Cover constructed of same material with solid gasket.
   5. Fittings:
      a. Ferrous metal construction electro-galvanized inside and out.
      b. Components critical to performance such as set screws, split rings, and locknuts constructed of hardened steel or adequately designed to insure positive bonds.

D. IMC (Intermediate Metal Conduit) is applicable in place of rigid heavy wall galvanized steel conduit in the following locations:
   1. All areas except primary raceways.
   2. Outdoors.

3. Underground.

E. Thinwall conduit:
   1. May be used in the following locations:
      a. Indoors in dry locations (walls, ceilings, exposed).
   2. Manufacturer: CONTRACTOR option.
   3. Conduit:
      a. Mild steel tube with an accurate circular cross section, a uniform wall thickness, a defect free interior surface, and a continuous welded seam.
      b. Interior and exterior surfaces thoroughly and evenly coated with zinc using the hot-dip galvanizing process.
   4. Fittings:
      a. Setscrew, steel construction electro-galvanized inside and out.
      b. Insulated throat connectors.
      c. Components critical to performance such as set screws, split rings, and locknuts constructed of hardened steel or adequately designed to insure positive bonds.

F. Flexible Conduit:
   1. Lengths limited to minimum necessary, 6' maximum.
   2. Limit use to dry areas.
   3. For connection of lighting fixtures, motors and similar equipment.
   4. To contain an equipment grounding conductor with phase conductors.
   5. Bond grounding conductor to equipment served and nearest conduit system junction box.
   6. Manufacturer: CONTRACTOR option.
   7. Usage:
      a. Use only in conjunction with electrical metallic tubing.
   8. Conduit:
      a. Single strip, helically wound, galvanized steel with smooth interior surface conforming to applicable UL Standards.
      b. Minimum size 1/2-inch may be used in lengths not to exceed 3-feet. All runs of flexible conduit shall be as short as practicable, of the same size as the conduit it extends and with enough slack to reduce the effects of expansion and vibration.
   9. Fittings:
      a. Connectors shall be malleable iron or steel with insulated throat, squeeze-type, with annular gripping rib. Particular attention shall be given to maintaining ground bond and firm support through flexible connections. Connections shall have insulated throats.

G. Liquid Tight Flexible Conduit:
   1. Requirements same as for flexible conduit.
   2. Use in areas where environment is damp or could become damp or wet.

3. To contain an equipment grounding conductor with phase conductors. Bond grounding conductor to equipment served and nearest conduit system junction box.
4. Manufacturer: CONTRACTOR option.
5. Usage:
    a. Use in conjunction with galvanized rigid metal conduit.
    b. Use in conjunction with PVC coated galvanized rigid metal conduit.
6. Conduit:
    a. Single strip, helically wound, galvanized steel core inside and outside with smooth interior surface with sunlight resistant thermoplastic jacket suitable for ambient environmental conditions conforming to applicable UL Standards.
    b. Jacket shall be positively locked to core to prevent sleeving.
    c. All runs of flexible conduit shall be as short as practicable, of the same size as the conduit it extends and with enough slack to reduce the effects of expansion and vibration.
7. Fittings:
    a. Where used in conjunction with galvanized rigid metal conduit, connectors shall be malleable iron or steel, electro zinc plated, with insulated throat and taper threaded hub.
    b. Where used in conjunction with PVC coated galvanized rigid metal or rigid aluminum conduit connectors shall be malleable iron or steel, electro zinc plated and PVC coated, with insulated throat and taper threaded hub.
    c. Particular attention shall be given to maintaining ground bond and firm support through flexible connections.
    d. All fittings shall be liquid tight.

H. Nonmetallic Conduit (PVC):
1. Where indicated on drawings.
2. In or under concrete slabs.
3. PVC conduit may be used for low voltage wiring (24 volts or less), where allowed by code. PVC may not be used in plenum rated ceilings or if another type has been called out on the drawings.
4. Where PVC conduit penetrates floor, it must be installed per conduit installation detail.
5. PVC not allowed indoors above slab, except for single ground conductors in non-plenum areas.
6. Manufacturer:
    a. Carlon.
    b. Or equal.
7. Conduit:
    a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.

b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-2.
c. The conduit and fittings shall be homogeneous plastic material free from visible cracks, holes or foreign inclusions. The conduit bore shall be smooth and free of blisters, nicks or other imperfections, which could mar conductors or cables.
d. Conduit, fittings and cement shall be produced by the same manufacturer to assure system integrity.

8. Conduit Bodies:
a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.
c. Stainless steel hardware.
d. Cover constructed of same material with solid gasket.

9. Fittings:
a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.

I. MC Cable:
1. MC cable shall not be used on this project.

2.03 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.
1. Intermediate Metal Conduit (IMC): Rigid steel.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit all steel fittings.

2.04 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.

B. Fittings: ANSI/NEMA FB 1 with insulated throats.

2.06 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, insulated throat connectors.

2.07 NONMETALLIC CONDUIT

A. Description: NEMA TC 2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.08 WIREWAYS

A. Description: General purpose type wireway.

B. Knockouts: Bottom only.

C. Size: As required.

D. Cover: Hinged.

E. Connector: Slip-in.

F. Fittings: Lay-in type with removable top, bottom and sides with captive screws.

G. Finish: Rust inhibiting primer coat with gray enamel finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify routing and termination locations of conduit prior to rough in.

B. Verify conduit routing. Routing as shown on Drawings is in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base conduit rough-in or equipment locations on dimensions obtained from the contract drawings.

B. Identify conflicts with the work of other trades prior to installation of electrical equipment and conduit work.

C. Adjust conduit system installation to satisfy field requirements.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

3.04 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. All conduit shall be installed in building unless indicated otherwise.
4. All conduits stubbed into ceiling shall have end bushings.
5. Install conduit in accordance with NECA "Standard of Installation."
6. Install nonmetallic conduit in accordance with manufacturer's instructions.
7. Arrange supports to prevent misalignment during wiring installation.
8. Support conduit using coated steel or malleable iron straps, lay in adjustable hangers, clevis hangers, and split hangers.
9. Group related conduits: support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
10. Fasten conduit supports to building structure and surface under provisions of Section 26 05 29.
11. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
12. Do not attach conduit to ceiling support wires.
13. Arrange conduit to maintain headroom and present neat appearance.
14. Route exposed conduit parallel and perpendicular to walls.
15. Route conduit in and under slab from point to point.
16. Do not cross conduits in slab.
17. Maintain adequate clearance between conduit and piping.
18. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
19. Cut conduit square using saw or pipecutter; de burr cut ends.
20. Bring conduit to shoulder of fittings; fasten securely.
21. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cleaner and cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
22. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

23. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Hydraulic one-shot bender may be used to fabricate factory elbows.
24. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
25. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
26. Provide suitable pull string in each empty conduit, except sleeves and nipples.
27. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
28. Ground and bond conduit under provisions of Section 26 05 26.
29. Identify conduit under provisions of Section 26 05 53.
30. Flexible metal conduit shall be used for connection to equipment subject to vibration and light fixture drops in all removable tile ceilings. Length shall not exceed 36" for equipment connections and 72" for light fixture connections. Minimum size 1/2", except 3/8" may be used for fixture drops. Install flexible conduit drops from independent junction box mounted above ceiling and accessible from below ceiling to recess ceiling mounted equipment. Allow for positioning of equipment to next tile increment.
31. Seal conduit with oakem or duct seal where they leave heated areas and enter unheated areas.
32. Surface raceway shall be installed to run parallel of all existing surfaces. Where raceway is used on ceiling, raceway shall be mounted at ceiling wall junction and extended from the junction box out to ceiling mounted device. Raceway shall be routed in corners and along moldings to be as least obtrusive as possible.
33. Exterior cable and conduit installation.
    a. Layout in trench may be started at either end unless the drawings indicate that it is to pitch for drainage. In which case the layout should be started at the lowest end. The cable and conduit shall be pitched 1" per 100 feet.
    b. Include all excavation and backfill.
    c. Cable and conduit shall be a minimum of 30" deep.
    d. Cable and conduit shall be laid in a 6" sand bed and covered with another 6" of sand before backfilling with earth.
    e. Provide Brady identotape 12" above all buried conduits and cables.
    f. Provide #12 pull wire in all empty or spare conduits.
    g. Restore existing surface back to its original condition.
    h. For all excavation, maintain erosion protection per Federal, State, and municipal requirements. All work associated with erosion control for excavation shall be done as per Federal, State and municipal requirements, as well as any plans, meetings, and other special conditions.

i. For all trenching that is under paved surfaces, backfill with structural material. Material shall be tapped in layers up to the point of the surface paving material.

34. For intermediate floor structural slabs, assume that conduit cannot be installed within the slab. If installing conduit within the slab, coordinate this with the Construction Manager and verify with the Architect prior to installation.

35. For on-grade slabs, the conduit may be run in or under the slab. Verify with concrete installation prior to running conduits in slab to determine if that conduit coordinates with the slab reinforcing.

B. Conduits Stubbed into Ceiling Space:

1. All conduits stubbed into ceiling shall have end bushings or insulated connectors.

C. Exterior Wall Penetrations:

1. For all exterior wall penetrations, patch the wall with material to match the existing wall finish. The openings shall be as small as possible to minimize the impact on the existing wall finish. Install duct seal within the conduit to prevent air flow.

2. When conduits are rising from the ground to penetrate the walls, furnish rigid steel conduit where conduit is exposed, and deep-back LB's condulettes or NEMA 4X stainless steel junction box.

D. Interface with Other Products:

1. Install conduit to preserve fire resistance rating of partitions and other elements.

2. Route conduit through roof openings for piping and ductwork or through suitable roof jack. Coordinate location with roofing installation.

END OF SECTION

SECTION 26 05 35

ELECTRICAL BOXES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.03 DESCRIPTION OF WORK

A. Furnish and install boxes as indicated on drawings and specified herein.

B. The intent of this section is to limit the use of sheet steel boxes to small circuit wiring in dry locations for installations of outlets, switches, exhaust fans, lights, unit heaters, small overhead door units, small power outlets, and limiting the general circuit capacity of 50 amps or less.

C. Outlets, switches, controls and etc., installed on machinery or processes shall be served with FS and NEMA 12 type boxes.

1.04 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 BOXES

A. Pull boxes and junction boxes: Metal construction, conforming to National Electrical Code, with screw on or hinged cover.

B. Flush mounted pull boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

C. Small surface type junction boxes to be used in dry locations only for general purpose lighting and outlets shall conform to the following standard sizes and spec's:

1. All boxes and covers shall be made of stamped steel. (No sectional boxes allowed).
2. Minimum sizes:

a.	Handy boxes	4 x 2 1/8 x 2 1/8
b.	Octagon boxes	4 x 1 1/2
c.	4" sq. boxes	4 x 1 1/2 or 4 x 2 1/8
d.	4 11/16" sq. boxes	4 11/16 x 2 1/8

D. Flush mounted outlet boxes used in dry locations shall conform to the following standards:
   1. All boxes and covers shall be made of stamped steel. No sectional boxes allowed.
   2. All boxes for communications outlets and blank outlets shall be of the "deep" variety.
   3. Minimum sizes:
      a. Masonry boxes: minimum 3 1/2" deep, gang as required. These can be used for outlets or blank outlets.
      b. 4" square wiring device boxes: 2 1/8" deep when used for communication or blank outlets. 1 1/2" or 1 1/8" deep when used for wiring devices. All 4" square boxes shall be equipped with square cut 1" raised covers of appropriate depth.
      c. Note special requirements for boxes that will be used in corrosive atmospheres, such as pools. In these atmospheres use corrosion resistant (PVC) outlet boxes.
      d. Note special requirements for flush boxes for outside receptacles. These boxes shall be 4-hole type or other type to properly patch the surface weather tight covers.

E. Junction and Splice Boxes:
   1. Screw covers, galvanized after fabrication and not less than code dimensions.
   2. Entry openings in boxes shall be made with knock-out punches or hole saws.
   3. Burning of entry openings with a torch will not be acceptable.
   4. Paint exposed ferrous surfaces, 2 coats rust resisting paint.

F. Provide outlet box divider barriers between 120/208 devices per N.E.C. and between switches for emergency and non-emergency circuits.

G. Flush interior devices shall utilize 4" square box with raised covers or deep masonry boxes as appropriate.

H. Raised covers to have square cut corners.

I. Where existing boxes are reused, provide add-a-depth device rings to devices installed without proper box depth to finish surface.

J. Box extensions will not be allowed.

K. Through the wall type outlet boxes not allowed.

L. Junction boxes and pull boxes shall not have knockouts. Enclosure type, material, and dimensions shall be as indicated on the drawings and as stated in these specifications. Where no type or size is indicated for junction boxes and pull boxes, they shall be one size larger than required by NEC.

M. For exterior outlets, such as receptacles, use FS type outlet box flush mounted.

N. Large junction boxes shall be constructed from steel in the following gauges:

Box Size	Minimum Steel Gauge
Up to 24" x 30" x 12"	14
24" x 36" x 8" to 36" x 36" x 16"	12
36" x 42" x 8" and larger	11

O. Boxes that are shown on hollow-core, precast concrete shall be flush mounted into the spancrete unless shown otherwise on drawings. Coordinate opening to be in hollow core. Provide opening.

2.03 SURFACE METAL RACEWAY BOXES

A. All outlet and junction boxes used with surface metal raceway shall be manufactured by the surface metal raceway manufacturer to be compatible with the raceway used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify routing and termination locations of conduit prior to rough in.

3.02 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

B. Mounting heights:
   1. As shown on drawings and details.
   2. Coordinate exact heights with specific manufacturer’s recommendations.
   3. All mounting heights of keypads and pushbuttons to be ADA compliant.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.

2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Boxes that are being installed in rough masonry surfaces (such as split face block) shall be installed in such a manner to allow the wiring device or light fixture and the associated device plate to be seated squarely. Have the masonry opening cut to the size of the plate and then box grouted in, or the rough masonry around the box shall be chiseled away and mortar installed around the box to provide a flat finish.

C. Coordinate with the masonry installation all details of installation on rough masonry surfaces. Without coordination assume responsibility for all costs to provide the flat surface, which will require chiseling the surface of the rough masonry away and providing mortar to obtain this smooth finish.

D. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

E. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

G. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

H. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods compatible with NFPA.

I. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices with each other.

J. Use flush mounting outlet boxes in finished areas.

K. Do not install flush mounting boxes back to back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic rated walls.

L. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

M. Use stamped steel bridges to fasten flush mounting outlet box between studs.

N. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

O. Use adjustable steel channel fasteners for hung ceiling outlet box.

P. Do not fasten boxes to ceiling support wires.

Q. Support boxes independently of conduit.

R. Use gang box where more than one device is mounted together. Do not use sectional box.

S. Use 2 gang box with plaster ring for single telecommunication outlets.

T. Use cast outlet box in exterior locations exposed to the weather and wet locations.

U. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
   1. Interior Dry Locations: Use hinged enclosure.
   2. Other Locations: Use surface mounted cast metal box.

V. Grounding:
   1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier's recommendations.

W. Interface with Other Products:
   1. Coordinate masonry cutting to achieve neat opening.
   2. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
   3. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

END OF SECTION

SECTION 26 05 37

LOCATION OF OUTLETS AND EQUIPMENT

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete installation as indicated on the drawings and as specified herein.

B. This specification lays out the general requirements for heights of devices. Heights of devices may be required to be changed depending on interferences in the walls or interferences with mechanical or other architectural equipment. Assume responsibility for verifying the existing conditions in the room by reviewing mechanical and architectural drawings so as not to interfere with that equipment.

C. Verification of door swings: Assume responsibility to verify door swings with the architectural plans prior to outlet box installation. Review if the switch location is such that it can be easily accessed upon opening the door.

1.04 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26, and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS (NONE)

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

C. All boxes to be plumb and level.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 EQUIPMENT

A. Specifications for equipment being installed under conditions set forth in this section shall be found in related work elsewhere.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify installation locations suitability and adjust as directed.

3.02 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

B. Mounting heights:
   1. As shown on drawings and details.
   2. Coordinate exact heights with specific manufacturer's recommendations.
   3. All mounting heights of keypads and pushbuttons to be ADA compliant.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section prior to installation.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Grounding:
   1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier's recommendations.

C. Location:
   1. Location of outlets and equipment as shown on plans is approximate. Verify exact location determined by:
      a. Construction or code requirements.
      b. Conflict with equipment of other trades.
      c. Equipment manufacturer's drawings.
   2. Minor modification to the location of outlets and equipment is considered a part of this specification and shall be made with no additional compensation.
   3. Mounting heights for all devices and equipment to be measured from finished floor to center of device and unless otherwise noted on plans shall be as follows:

Switches	42"	
Receptacles	22"	
Above Counter receptacles	-	Mount just above backsplash for above counter outlets. See floor plan general notes.
Communication outlets	-	Match adjacent receptacle outlet. If receptacle outlet is not shown, provide 22" above floor to center of device or 8" above counter.
Wall Telephone	42"	
Volume Control	42"	
Blank Outlets	-	Match receptacle height located adjacent to it unless stated otherwise on plans

D. Check Heating and Ventilating Plans for location of baseboard heating elements or wall radiators and mount equipment accordingly.

E. Receptacles below counter: Verify the actual mounting height with architect. Determine if device is to fit into knee space and rough-in accordingly.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.03 DESCRIPTION OF WORK

A. Furnish and install complete labeling as specified herein.

B. All major pieces of electrical equipment shall have engraved labels indicating their functions. This shall include the following:

1. All pushbuttons shall have labels that are engraved as to its function.
2. All relay cabinets shall indicate what the relay cabinet's function is.
3. All bypass relay enclosures.
4. Provide engraved tags for all air handling units, including HVAC units. Each unit shall be adequately marked with a tag indicating what unit number it is. An engraved tag shall also be provided on all air handling units which have smoke detector shut down. This tag shall indicate the following: "This air handler is equipped with smoke detector shut down. In the event that smoke is sensed in the ductwork, the air handler will turn off".
5. All panelboards, starters, disconnects, transfer switches, switchboards, motor control centers and transformers shall have engraved labels indicating their functions.
6. Provide engraved tags for all special pull and junction boxes that are associated with the building special systems.
7. Provide typewritten label for all microphone outlets and auxiliary inputs. Label shall indicate what the receptacles function is; i.e. microphone, auxiliary input, auxiliary output, and shall have a number associated with them which corresponds to a number on the patch panel in the amplifier.
8. Provide engraved tags for all systems keys. See details for, lab tables shut downs, FCE shut downs, and computer rooms.
9. Provide all spare keys and tags as indicated for keyed switches.

C. Low Voltage Systems:

1. Provide labeling for all low voltage cabling, both ends within 3” of termination point and low voltage device plates. Color coding to be maintained for each system independently.
2. Each component of the system to be clearly marked as to manufacturer, part number, and any special designation on drawing.
3. All patchpanels, racks, and modular plates in patchpanels to be labeled.

1.04 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning.

B. Division 26 and 27: Electrical.

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATIONS & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 ENGRAVED LABELS

A. Where the words "provide engraved label" appears on the drawings or in the specifications, it shall mean that the label shall be an engraved 3-layer phenolic label with black letters on white material, unless other colors are called out on the drawings or details.

B. The label size shall be a minimum of 3/4" high and be 3" long. Labels may be attached with double backed adhesive tape unless indicated otherwise.

C. Where references are made on the drawings to provide engraved labels, engraved nameplate or engraved plates, these should be engraved phenolic labels.

2.03 ENGRAVED PLATES

A. Where references are made to engraved plates, this shall mean that the normal device plate shall have an engraving on it with black letters so as to indicate what this switch or device is used for.

2.04 BRANCH CIRCUIT OUTLETS: LABELING

A. Each branch circuit outlet, receptacles, lighting, and any other device requiring 120/208 or 277/480 volt power, the contractor shall:
   1. Provide circuit, written in pencil or non-washable ink, inside of outlet box in an area that can be easily viewed when removing outlet faceplate.
   2. Write circuit number in ink on device between receptacles under plate.
   3. Optional: Provide typed label (not dyno label) for each circuit attached to device plate.
   4. Label each junction box outlet cover in non-washable marker as to circuit number routed through junction box.

2.05 PANELBOARDS: LABELING

A. Panelboard Directory:
   1. Prepare and affix a typewritten directory to the inside cover of each panelboard indicating loads controlled by each circuit.
   2. Each distribution and lighting panelboard shall be equipped with a typewritten directory accurately indicating rooms and/or equipment being served.
   3. Assume that originally directories will have to be developed based on the room numbers on the project drawings.
   4. Near project completion, all directories will have to be changed to reflect actual room numbers as designated by the building occupant.
   5. Include the cost of doing the original handwritten directory and revisions to the directory based on occupant room numbers.
   6. Each existing panelboard that is revised, modified or has had circuits deleted or added to, shall have its directories updated to reflect existing circuits and all modified circuits after existing circuits have been verified per specification section 26 05 02.

B. Panelboard Identification:
1. Label per NEC 210.5.
2. Identify each panel with a suitably engraved nameplate mounted at the top of the front cover.
3. The nameplates shall be made of laminated black and white plastic with white on the outside.
4. The lettering shall be 1/4 inch high (minimum), engraved by cutting through the white outside layer so that the letters appear black.
5. Fasten nameplates with brass or stainless steel panhead screws.
6. Nameplate engraving shall match the numbers or letters shown on the drawings or assigned by the Owner's Representative.
7. Labels shall be engraved as to the function of the circuit breaker.
8. Labels shall also be engraved to indicate the load served by the circuit breaker.

C. Identify the source of the feeder circuit serving the panelboard.

2.06 STARTERS, DISCONNECTS, AND VFD'S

A. Each starter, disconnect, and VFD furnished by this section or furnished by other sections but installed by this section shall have an engraved laminated label indicating which piece of equipment it controls.

B. This requirement is waived if the disconnect or starter is attached directly to the piece of equipment that it is controlling or operating.

2.07 COMMUNICATIONS SYSTEM CABLES IDENTIFICATION

A. Communication system cables are defined as:
1. All low voltage cabling, not 120 volt.

B. See data specification section

C. Labels shall be overwrap type "Panduit PLL or PDL type" or equal labels by Brady.

2.08 COMMUNICATIONS SYSTEM DEVICES

A. Communication system devices are designated as:
1. Data outlets in rooms.
2. Data outlets at patchpanel.

B. Each label shall be a computer generated, laser printed, adhesive type label; either clear or white.

C. The labels shall be attached to each of the plates so that the device on the plate can be easily identified.

D. Provide Panduit PLL series type label, or equal by Brady.

2.09 MISCELLANEOUS

A. Branch circuits:
   1. On branch circuits, use shall be made of all standard wire insulation colors available.
   2. Where wires of different systems junction in a common box, each cable shall be grouped with its own system and identified using tags or identification strips.

B. Special systems:
   1. All control, instrumentation, graphic display, alarm and other special system wires shall be clearly identified by description and location, using tags or identification strips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify surfaces are cleaned and ready to receive labels.

B. Verify labels are correct.

C. Verify that labels are installed as specified, level and plumb.

3.02 FIELD MEASUREMENTS (NONE)

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

3.04 INSTALLATION

A. General:
   1. Degrease and clean surface prior to installing labels.
   2. Install nameplate and label parallel to equipment lines.
   3. Secure nameplates to equipment fronts using screws, if so specified on drawings.
   4. Identify Raceways of Certain Systems with Color Banding:
      a. Band exposed or accessible raceways of the following systems for identification.
      b. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two.
      c. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.

d. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROLS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 National Electrical Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to current NEMA Enclosure Standards.

E. Conform to NEMA Standard WD-7-2000.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete lighting control system as shown on the drawings and as specified herein. This equipment shall provide the following functions:
   1. Control of emergency lighting through the use of bypass relays when generator runs.
   2. Control of other lighting as shown on the drawings.
   3. Control of exterior lighting through photo-eye as shown on the drawings.
   4. Dual technology, PIR and ultrasonic motion sensor lighting controls. All motion sensors to have dual contacts to allow for HVAC connection to exhaust fans in bathrooms.
   5. Photo sensors

1.04 RELATED WORK ELSEWHERE

A. Division 09: Finishes.

B. Division 11: Equipment

C. Division 26, 27, and 28: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:
1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Submittal drawings are required for the following systems. They shall include the following:
a. Dual technology, Passive infrared and ultrasonic lighting controls.
1) Drawing showing all switches, and sensors and connections between all devices and lighting circuits.
2) Cut sheets on components.
3) Proper circuit numbers shall be shown on drawings.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 PRODUCTS

2.01 BYPASS RELAYS/CONTACTORS

A. Function: It is the intent that the bypass relay provide bypass system to normal switching when there is a power fail and the generator runs. This shall be accomplished with the use of a UL924 listed emergency power bypass device. See detail on drawings.

B. Acceptable manufacturers: Wattstopper – ELCU-200 or equal. Bypass relay must interface with photo sensor, motion sensor and dimming system components.

C. Review the drawings to determine the location of the bypass relay panels. Each bypass relay shall be provided adjacent to a panelboard and an engraved red label shall be provided indicating its function. The label should describe the area of lighting bypass; i.e. gymnasium, IMC, etc.

D. The low voltage relay submittal drawings shall include, as part of the drawing submittal, the low voltage relays showing all interconnections.

2.02 DUAL TECHNOLOGY CEILING MOUNTED LIGHTING CONTROL

A. Provide dual technology type lighting controls in all areas unless directed to use single technology ultrasonic or passive infrared technology.

B. Provide second contact in all sensors to accommodate HVAC interface.

C. Determine proper sensor type and relay for direct connection requirements. Provide appropriate units.

D. Employ the services of a manufacturer’s appointed representative to assist in making the proper adjustments on the motion detector installation. Meet with this person prior to making installation to determine if the locations shown are appropriate for the type of device being furnished. Make modifications in the locations for the devices, if required, to provide a more adequate installation.

E. Modify time settings, sensitivity settings, and "initial on" and "keep on" controls as necessary, and as required for the space. Default time of 15 minutes “keep on” time will be used at initial activation.

F. Installation assistance:
   1. Include time in bid to work with the Owner and manufacturer to determine the proper time setting and sensor setting for each of the motion switches.
   2. Each of the switches shall be set for the type of space in which they operate.
   3. Include time in bid to have the manufacturer’s representative come on site and review the job to determine what the expected settings are for the equipment.

G. Zero crossing relay controls shall be supplied.

H. Dual technology occupancy sensors shall be capable of detecting presence in the floor area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.

I. Ultrasonic sensing shall be volumetric in coverage.

J. Passive infrared sensing shall utilize a multi-element fresnel lens to ensure that the sensor is insensitive to short-wavelength infrared waves such as those emitted by the sun. Lens shall have grooves facing in to avoid dust and residue build up which affect ir reception.

K. Both technologies shall sense presence in floor area before lighting will turn on. Detection by either technology shall hold lighting on for set period of time.

L. Sensors shall have time-out adjustment from 15 seconds to 35 minutes. Sensor shall not have settings exceeding 35minutes.

M. Sensors shall cover 2000 square feet with standard lens and 90 linear feet with long-range lens for walking motion in corridors. Coverage meeting NEMA Standard WD 7-2000 will be required.

N. Sensors shall be capable of being networked to achieve adequate coverage.

O. Sensors shall have an isolated relay rated at 24VDC that can be used to interface with HVAC, EMS, and other monitoring systems.

P. Each sensing technology shall have independent sensitivity adjustments, time adjustments and led display.

Q. Sensitivity and timer control shall be accessible on the front of the sensor. Sensor shall incorporate an accessible but recessed on/override device.

R. Sensors shall operate on 24VDC.

S. Power supply shall be provided by a power pack that consists of a transformer and contact relay in one unit.

T. Provide 18 gauge plenum rated cable for interconnection of centers to relays.

U. Sensor shall have standard 5 year warranty and shall be UL listed.

V. Approved venders are Watt Stopper or equal

2.03 ULTRASONIC CEILING MOUNTED LIGHTING CONTROL

A. Where so indicated, provide an ultrasonic lighting control.

B. Provide second contact in all sensors to accommodate HVAC interface.

C. Determine proper sensor type and relay for direct connection requirements. Provide appropriate units.

D. Employ the services of a manufacturer's appointed representative to assist in making the proper adjustments on the motion detector installation. Meet with this person prior to making installation to determine if the locations shown are appropriate for the type of device being furnished. Make modifications in the locations for the devices, if required, to provide a more adequate installation.

E. Modify time settings, sensitivity settings, and "initial on" and "keep on" controls as necessary, and as required for the space. Default time of 15 minutes "keep on" time will be used at initial activation.

F. Installation assistance:
   1. Include time in bid to work with the Owner and manufacturer to determine the proper time setting and sensor setting for each of the motion switches.
   2. Each of the switches shall be set for the type of space in which they operate.
   3. Include time in bid to have the manufacturer's representative come on site and review the job to determine what the expected settings are for the equipment.

G. Zero crossing relay controls shall be supplied.

H. Ultrasonic sensing shall be volumetric in coverage.

I. Ultrasonic occupancy sensors shall be capable of detecting presence in the floor area by detecting doppler shifts in transmitted ultrasound.

J. Sensors shall have time-out adjustment from 15 seconds to 35 minutes. Sensor shall not have settings exceeding 35minutes.

K. Sensors shall cover 2000 square feet with standard lens and 90 linear feet with long-range lens for walking motion. Coverage meeting NEMA Standard WD 7-2000 will be required.

L. Sensors shall be capable of being networked to achieve adequate coverage.

M. Sensors shall have an isolated relay rated at 24VDC that can be used to interface with HVAC, EMS, and other monitoring systems.

N. Sensors shall have adjustable ultrasonic sensitivity sensor shall have independent sensitivity adjustments, time adjustments and led display.

O. Sensitivity and timer control shall be accessible on the front of the sensor. Sensor shall incorporate an accessible but recessed on/override device.

P. Sensors shall operate on 24VDC.

Q. Power supply shall be provided by a power pack that consists of a transformer and contact relay in one unit.

R. Provide 18 gauge plenum rated cable for interconnection of centers to relays

S. Sensor shall have standard 5 year warranty and shall be UL and CUL listed.

T. Approved venders are Watt Stopper or equal

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.02 FIELD MEASUREMENTS (NONE)

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:
1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.
4. Low voltage cabling or controls cannot be painted and must be installed after painting is complete or masked prior to painting.

B. Cleaning:
1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Install products in accordance with manufacturer's instructions.

D. Install devices plumb and level.

E. Install switches with off position down.

F. Labeling:
1. Each panel enclosure shall be labeled as to its function.
2. Each bypass switch and bypass relay shall have engraved labels indicating their functions.

G. Installation:
1. Utilize plenum rated Cat 5e cabling (green) to connect devices on Digital dimming system local network.
2. Provide pre terminated cat 5 cabling, length as required.
3. Install the work of this section in accordance with manufacturer's printed instructions unless otherwise indicated.

H. Programming:
1. Calibrate settings for time delay, sensitivity, fade rates, etc. to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
2. Set sensor and switching zones as required for application.
3. Set time switch settings as required for application.
4. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
   a. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
   b. Sequence of operation (e.g. manual ON, Auto OFF, etc.)
5. After 30 days of occupancy, re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

I. Factory Services:
1. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
2. The contractor shall provide both the manufacturer and the electrical engineer with 3 weeks written notice of the system start up and adjustment date.
3. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.

3.05 OWNER TRAINING

A. Provide complete operator training for the Owner's personnel.

B. Provide minimum one hour training on the operation of each system in this section.

C. Owner representative shall specifically be shown how the bypass lighting system operates and how he may bypass each of the lighting circuits by operating the bypass switch as part of the control system.

3.06 SPARE EQUIPMENT (NONE)

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:
   1. NFPA70 – National Electrical Code.

B. National Electrical Contractors Association (NECA), Standard of Installation, current edition.

C. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:
   1. NEMA PB 1 - Panelboards
   2. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
   3. NEMA AB 1 - Molded Case Circuit Breakers.
   4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

D. Underwriters Laboratories, Inc. (UL), Specifications and Standards, current edition:
   1. UL 50 - Enclosures for Electrical Equipment
   2. UL 67 - Panelboards.
   3. UL 98 - Enclosed and Dead-front Switches
   4. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures

E. Canadian Standards Association (CSA), Specifications and Standards, current edition:
   1. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
   2. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers

F. Federal Specifications and standards, current edition:
   1. W-P-115C - Type I Class 1
   2. W-C-375B - Molded Case Circuit Breakers
   3. W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

G. American Society of Testing Materials (ASTM), Specifications and Standards, current edition.

1.03 DESCRIPTION OF WORK

A. Furnish and install complete and operable Distribution and Branch Circuit Panelboards system as indicated on the drawings and as specified herein.

1.04 RELATED WORK ELSEWHERE

A. Division 26 and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the above:
   1. Manufacturer literature sufficient in scope to demonstrate compliance with the requirements of this specification.
   2. Overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. Illustrate one line diagrams with applicable voltage systems.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The panelboard manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

C. All panelboards provided under this section shall be the products of a single manufacturer specializing in manufacture of panelboard products with a minimum of fifty years documented experience.

D. Provide all necessary accessories required for a complete and operable system.

1.08 WARRANTY

A. Panelboards shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Provide a complete and fully functional distribution system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

2.02 600VAC POWER DISTRIBUTION PANELBOARDS

A. Manufacturers:
   1. Square D Company I-LINE – Class 2110
   2. Eaton equal

B. Interior:
   1. Rated 600 vac or 250 VDC maximum. Continuous main current ratings as indicated on drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
   2. UL Listed short circuit current ratings as indicated on the drawings with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment.
   3. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
   4. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two U-shaped steel channels, permanently secured to a galvanized steel mounting pan by fasteners.

5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
6. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the drawings.
7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. UL Listed panelboards with 200 percent rated solid neutrals shall have plated copper neutral bus for non-linear load applications where indicated on the drawings. Gutter-mounted neutral will not be acceptable.
8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

C. Group mounted circuit breakers through 1200A:
1. Circuit breakers shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
2. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.
3. Line-side circuit breaker connections shall be jaw type.
4. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
5. Thermal magnetic molded case circuit breakers
    a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
    b. Circuit breakers shall be suitable for the interrupting rating indicated on the drawings.
    c. Where true current limiting circuit breakers are indicated on the drawings, manufacturer shall submit one set of published let-through curves (as required by UL) to the owner.
    d. Ampere ratings shall be as shown on the drawings.
    e. Provide for all branch circuit breakers, unless indicated otherwise on the drawings.

D. Enclosures:
1. Type 1:
    a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvannealed steel will not be acceptable.

b. Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.

c. Maximum enclosure dimensions shall be 44-inches wide and 9.5-inches deep.

d. Type 1 Trim Fronts:

1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.

2) Trim front shall be hinged 1-piece with door suitable for flush or surface mount as indicated on the drawings. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.

3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

2.03 240VAC LIGHTING AND APPLIANCE PANELBOARDS

A. Manufacturers:

1. Square D Company NQ – Class1640
2. Eaton equal

B. Interior:

1. Rated for 240 vac/48 VDC maximum. Continuous main current ratings, as indicated on the drawings, not to exceed 600 amperes maximum.
2. UL Listed short circuit current ratings as indicated on the drawings with a maximum of 200,000 RMS symmetrical amperes.
3. Provide one continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. Main lug and main breaker panelboards shall be suitable for use as Service Equipment.
4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
5. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the drawings.

6. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200 percent rated solid neutrals shall have plated copper neutral bus for non-linear load applications where indicated on the drawings.
7. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twist-outs covering unused mounting space.
8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
9. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Interior leveling provisions shall be provided for flush mounted applications.

C. Main Circuit Breaker:
1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
3. Circuit breaker handle and faceplate shall indicate rated ampacity. Circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position where indicated on the drawings.
5. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 75 degree C rated wire or 90 degree C rated wire as required by the application. Lug body shall be bolted in place; snap-in designs are not acceptable.
6. The circuit breakers shall be UL Listed for use with and provided with the following accessories where indicated on the drawings: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

D. Branch Circuit Breakers:
1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the drawings.
2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of the circuit breaker housing.
5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
6. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 75 degree C rated wire or 90 degree C rated wire as required by the application.
7. Breakers shall be UL Listed for use with the following accessories where indicated on the drawings: Shunt Trip, Auxiliary Switch, and Alarm Switch.

E. Enclosures:
1. Type 1:
a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
c. Box width shall be 26-inch wide maximum.
d. Type 1 Fronts:
1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
2) Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on the drawings.
3) Panelboards shall have fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

B. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

C. Start work only after unsatisfactory conditions are corrected.

D. Inspect completed installation for physical damage, anchorage, and grounding.

E. Perform tests according to panelboard manufacturer's instructions.

F. Tighten bus connections and mechanical fasteners.

G. Touch-up scratched or marred surfaces to match original finish.

3.02 FIELD MEASUREMENTS

A. Field verify locations of panelboards with other trades. Adjust as required to meet field conditions and code requirements. Do not base exact panelboard locations on the contract drawings.

B. Identify conflicts with the work of other trades prior to installation of electrical equipment.

C. Adjust panelboard installation to satisfy field requirements.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Do not store exposed to weather.

C. Physically protect against damage from work of other trades.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.
   3. Coordinate painting of covers for flush mounted panelboards located in finished areas.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Grounding:
1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

D. Install panelboards so that circuit breakers are not more than 6 feet above the finished floor or grade.

E. Where panelboards or auxiliary cabinets are flush mounted in an outside wall, insulate the enclosure back and sides with 1/2 inch rigid fiberglass insulation and vapor barrier.

F. Selectively connect branch circuits to equally balance currents in the panelboard busses.

G. For each emergency panelboard, provide an engraved red nameplate with white lettering that indicates the following:
1. "This electrical device is being fed from more than one location. Prior to servicing, all sources of power to this panel shall be disconnected."
2. This label shall comply with the requirements stated in specification section 26 05 53.

H. See Section 26 05 29 for equipment mounting.

I. Install panelboards plumb and flush with wall finishes.

J. Install panelboards such that top of panel is located at an elevation of 6-feet above finished floor elevation.

K. Provide filler plates for unused spaces in panelboards.

L. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. See Section 26 05 53.

M. Stub five empty 1-inch conduits to accessible location above ceiling and additional five empty 1-inch conduits below floor (if space exists) of each flush-mounted panelboard to allow for future expansion.

N. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent. Take care to maintain proper phasing for multi wire branch circuits.

O. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

P. Verify that bonding jumper is properly installed in service entrance rated panels.

Q. Thoroughly clean and remove construction debris from panelboard interior and exterior.

3.05 OWNER TRAINING

A. Provide complete operator training for the Owner's personnel.

B. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

3.06 SPARE EQUIPMENT

A. As shown on panel schedules.

B. All spare breakers listed on panel schedules to be mounted in panelboards.

END OF SECTION

SECTION 26 27 02 – MOTOR WIRING

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.03 DESCRIPTION OF WORK

A. Furnish and install complete connections and wiring to motors as indicated on the drawings and as specified herein.

B. Check the drawings and specifications of all other divisions of work for equipment and work which must be included whether or not shown on the electrical drawings, in order to provide a complete electrical installation.

C. Install all motor starters.

D. Coordinate motor installation with other divisions of work.

E. Furnish overload devices for motor starters.

1.04 RELATED WORK ELSEWHERE

A. Division 23 – Heating, Ventilation and Air Conditioning.

B. Division 26 – Electrical.

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.08 WARRANTY

A. Installation shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is in compliance with approved submittal drawings.

3.02 FIELD MEASUREMENTS (NONE)

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Motor starters shall be furnished by the division of work supplying the motor requiring a starter except where specifically stated otherwise on the electrical drawings.

C. Check the drawings and specifications of the other divisions to determine the requirements for motor disconnect switches and disconnects furnished by other divisions.
   1. Install all required disconnect switches.
   2. Provide all code required disconnect switches not specifically supplied by others.

D. Unless otherwise indicated on the drawings or elsewhere in these specifications, all motors shall be furnished by others.

E. Motors shall be set in place by others and the associated motor starters, controllers, and disconnects shall be turned over for installation.

F. Control wiring, regardless of voltage, shall be the responsibility of the division providing the motor unless specifically indicated otherwise on the electrical drawings.

G. Furnish and size the overload protection as required for the motor load.
   1. Thoroughly investigate the equipment connection schedules and other portions of the contract drawings to determine the extent of work required for connections to equipment furnished by others.

H. The National Electric code requires that a duplex receptacle be installed on the roof any time there is roof mounted equipment installed.
   1. Provide a heavy-duty weatherproof ground fault receptacle on the roof near the roof mounted air conditioning, refrigeration, and heating equipment.
   2. The outlet box shall be an FS cast iron type.
   3. This receptacle may be attached to an equipment supporting leg or other similar apparatus on the roof, or if none is available, shall be supported using a supporting framework.
   4. The receptacle feed conduits shall be stubbed through the roof using a weatherproof boot.
   5. This receptacle shall be connected to the nearest available panel and connected to a 20 amp circuit breaker unless shown otherwise on plans.
   6. This receptacle shall be furnished whether or not it is explicitly shown on the drawings.

I. Final Testing:
   1. Prior to energizing any equipment whether installed by this section or not:
   2. First make a thorough inspection of it to make sure it has been unpacked correctly and all packing materials and supports have been removed.

3. Be responsible for assisting the equipment start up personnel to assure correct equipment connections and rotation.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Device specific standards and requirements are included in device specifications.

1.03 DESCRIPTION OF WORK

A. Provide and install wiring devices as required on the drawings and as specified herein.

1.04 RELATED WORK ELSEWHERE

A. Division 09: Finishes.

B. Division 11: Equipment

C. Division 26: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:
   1. One sample of each switch will be supplied to Electrical Engineer, for review prior to installation.
   2. One sample of each receptacle will be supplied to Electrical Engineer for review prior to installation.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

D. Store wiring devices and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 WALL SWITCHES

A. Switches shall be:
   1. UL listed for current and voltages indicated.
   2. Shall comply with NEMA standard publication WD-1, “Heavy Duty Wiring Devices”.
   3. Federal Specifications Test WS-896 E.
   4. UL standard 20, 943 class A (GFCI) and 498.

B. Switches shall be 20 ampere heavy duty specification grade unless noted.

C. Switches shall have provisions for back and side wiring, screw clamp type suitable for solid or stranded wire with separate green ground screw.

D. Switches shall be ivory to match existing unless noted as different by architect.

E. Switches shall be made of nylon or high impact resistant material.

F. Modular switches with pigtailed terminals are allowed.

G. Supply the following:
1. Wall switch with:
a. 20 ampere, 120/277 volt rating.
b. Toggle handle.
c. Single-pole, double-pole, 3-way and 4-way switches shall be available.
d. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.
2. LED slide dimmer switch for all non-photo sensor circuits.
a. Appropriate for specified dimming LED driver.
b. Push button on/off with indicator light.
c. Preset levels may be maintained by use of On/Off push button
d. Power leads may be integral.
e. Solid state circuitry.
f. Heat sink.
g. Radio/TV interference filter.
h. Surge protection, 6000V, 200A.
i. Electrostatic discharge protection up to 16,000V.
j. Power failure memory.
k. Face plate.
l. Dimmer shall not require a minimum load.
m. Color to match other wiring devices.
n. Available in single-pole and 3-way.
o. Provide appropriate dimmer to all for operation with motion sensor, photo sensor and emergency bypass switch as shown on plans. Switch manufacturer to be same manufacturer as other devices.
p. Provide separate switch box for all low voltage 0-10V dimmers.

2.03 RECEPTACLES

A. Receptacles shall be:
1. UL listed for current, uses and voltages indicated.
2. Shall comply with NEMA standard publication WD-1 and WD-6 standards.

B. Colors shall be ivory to match existing.

C. Receptacles shall be specification grade unless noted.

D. Receptacles (with the exception of GFCI) shall have one piece brass strap.

E. Receptacles shall have provisions for back and side wiring, screw clamp type suitable for solid or stranded wire with separate green ground screw.

F. Receptacles shall be white unless noted as different by architect.

G. Modular receptacles with pigtailed terminals are allowed.

H. Receptacles shall be made of nylon or high impact resistant material.

I. Receptacles installed in wet or damp locations shall be weather resistant.

J. Receptacles shall be supplied with face plate.

K. Supply the following:
   1. Duplex NEMA 5-20R heavy duty straight blade (Tamper Resistant) receptacles with:
      a. 20 ampere, 120 volt rating.
      b. Standard face shape.
      c. 2-pole, 3-wire grounding
      d. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.
   2. USB double NEMA 5-20R heavy duty straight blade (Tamper Resistant) receptacles with:
      a. Two 2.1A USB ports
      b. 20 ampere, 120 volt rating.
      c. Decora face shape.
      d. 2-pole, 3-wire grounding
      e. Approved vendors are: Cooper, Hubbell Wiring, Leviton and Pass & Seymour.
   3. GFCI Duplex NEMA 5-20R (Tamper Resistant) receptacles with:
      a. 20 ampere, 125 volt rating.
      b. Standard GFCI face.
      c. GFCI compatible face plate.
      d. 2-pole, 3-wire grounding.
      e. Approved vendors are: Cooper, Hubbell Wiring, Leviton, Pass & Seymour.
   4. Heavy duty flush single straight blade receptacle with:
      a. Standard face shape.
      b. NEMA 5-15R
         1) 15 ampere, 125 volt rating.
         2) 2-pole, 3-wire grounding.
      c. NEMA 5-20R
         1) 20 ampere, 125 volt rating.
         2) 2-pole, 3-wire grounding.
      d. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

2.04 PLATE COVERS

A. All plate covers shall be ivory (match existing) smooth lexan or nylon.

B. Cast metal plates: Die cast profile, ribbed for strength, flash removed, primed with gray enamel, furnished complete with four mounting screws.

C. Steel plates: Hot dip galvanized 1.25 oz /sq. ft. minimum.

D. Weatherproof receptacle plate shall be heavy duty type, cast aluminum with a deep cover hood to provide weatherproof protection while an attachment plug cap is inserted. Plate shall be code approved as "suitable for wet locations while in use". Weatherproof cover shall be provided with ¼"padlock hole. Plate must meet OSHA lockout/tagout requirements. Provide a padlock for each weatherproof receptacle cover installed on the project. All padlocks shall be keyed alike. Provide twenty spare keys for Owner's use.

E. Surface box plates: Beveled, steel, pressure formed for smooth edge to fit box.

F. Where two-gang boxes are required for single gang devices, provide special plates with device opening in one gang and second gang blank.

G. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and will be completely covered by wall plates.

C. Verify floor boxes are adjusted properly; plumb and level.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

E. Inspect each wiring device for defects.

F. Operate each wall switch with circuit energized and verify proper operation.

G. Verify that each receptacle device is energized.

H. Test each receptacle device for proper polarity.

I. Test each GFCI receptacle device for proper operation.

J. Test that each receptacle is properly grounded.

K. Adjust devices and wall plates to be flush and level.

3.02 FIELD MEASUREMENTS

A. Field verify proper location of all wiring devices with field conditions and adjust accordingly.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
   3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Install products in accordance with manufacturer's instructions.

C. Install devices plumb and level.

D. Install switches with OFF position down.

E. Install vertical receptacles with grounding pole on top and horizontal receptacles with grounding pole to left.

F. Connect wiring device grounding terminal to outlet box with bonding jumper.

G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

H. Connect wiring devices by wrapping solid conductor around screw terminal or inserting into wire clamp. Wrapping conductor not allowed for stranded wire.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

J. Mount switches at heights shown in specification 26 05 37 unless otherwise noted. Coordinate location with architectural detail.

K. In areas where ceiling mounted receptacles and outlets are shown, the face of the receptacle or outlet is to be flush with the ceiling finish. For grid ceilings, provide proper support framing such that receptacles and outlets can be used from the ceiling below without damaging the ceiling tile.

L. Preparation:
1. Provide extension rings to bring outlet boxes flush with finished surface.
2. Clean debris from outlet boxes.

3.05 OWNER TRAINING (NONE)

3.06 SPARE EQUIPMENT (NONE)

END OF SECTION

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SECTION 26 27 28

CIRCUIT & MOTOR DISCONNECTS

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

1.03 DESCRIPTION OF WORK

A. Furnish and install heavy-duty fusible type disconnect switches of types scheduled at locations shown on the drawings and as specified herein.

B. Furnish and install other disconnect switches as necessary and required with proper number of poles, voltage and enclosure type ratings as required for the application and as required by the National Electrical Code.

C. The drawings may or may not indicate disconnects. Disconnects shown on drawings shall be installed for that piece of equipment, even if the disconnect is not required by code.

D. Provide proper environmental enclosure for disconnect depending on the mounting location.

E. Provide fused or non-fused disconnect as required for proper protection of the equipment.

F. Provide all code required disconnects. Assume responsibility for reviewing equipment connections and starting equipment provided with the equipment and determining if disconnects are required.

G. For fused disconnects, provide appropriately sized fuses for the equipment.

H. Install and wire mechanical system starters. See other portions of specifications indicating requirements for work.

1.04 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26, and 27: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.08 WARRANTY

A. Equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 DISCONNECTS

A. Disconnect switches shall be heavy duty switch operated type with cover interlock and enclosed arc chamber, quick make and quick break and provision for padlocking in either the open or closed position. All heavy duty, safety switches 30 to 600A, shall be provided with Class R rejection style fuse clips. The combination rating of the heavy-duty switch and R fuse shall be 200,000 symmetrical amps and labeled as such.

B. Approved manufacturers: Square D.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.02 FIELD MEASUREMENTS

A. Field verify locations of disconnects with other trades. Adjust as required to meet field conditions and code requirements.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:
   1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
   2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
   3. Mount per Section 26 05 29.

B. Cleaning:
   1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
   2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
   3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Motor and Equipment Connections:
   1. Check HVAC motor schedule to ascertain if disconnect is required at motor. If disconnect is not shown on drawing and the NEC requires a disconnect, it shall be furnished and installed by this Division 26.
   2. The location of motors and motor equipment shown on plans including disconnect switches and starters are approximate unless otherwise specified. Obtain the exact locations from the Architect or from Division furnishing the equipment.

3. Other contractors will furnish combination starters for installation. Refer to the HVAC drawings to determine starter locations. If starter locations are not indicated, determine best starter location on site.
4. Where a combination starter is indicated on the HVAC motor starter schedule and has a disconnect as part of it, a separate disconnect shall not be required.
5. HVAC temperature control connections will be done by the HVAC temperature control contractor.

3.05 OWNER TRAINING

A. Provide one hour minimum training on operation and troubleshooting each system in this section.

3.06 SPARE EQUIPMENT

A. Provide one set of spare fuses for each fusible disconnect provided.

END OF SECTION

SECTION 26 51 13

INTERIOR LIGHTING FIXTURES

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to Wisconsin Administrative Code, Comm. 63.

D. Conform to National Fire Protection Association NFPA 101.

E. Conform to American National Standards Institute ANSI C 82.11-1993

F. Conform to current National Electrical Manufactures Association Standards.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete interior lighting system as required on the drawings and as specified herein.

1.04 RELATED WORK ELSEWHERE

A. Division 09: Finishes

B. Division 23: Heating, Ventilation and Air Conditioning

C. Division 26: Electrical

1.05 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:
   1. Submit color samples as requested.
   2. Fixtures specified as “RAL color to be determined” shall:
      a. Include one RAL color swatchbook equal to PPG ENVIRPCRON Powder coatings Classic RAL Color Deck with submittals.
      b. RAL color choice will be returned with submittals.

c. One 2” x 2” metal color sample chip of approved RAL color shall be submitted within 30 days of return of submittals containing RAL color choice. Chip shall be labeled with RAL number.

d. Submittal documents accompanying RAL 2” x 2” metal color sample chip will be returned with notification of acceptance or rejection. Chip shall be retained for records.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

D. Install lamps and test fixtures for proper operation and make all ready for use by Owner.

1.08 WARRANTY

A. Lighting fixtures shall be warranted for a period of not less than 2 years from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.02 FIXTURES AND COMPONENTS

A. Each bidder shall make his own count of all fixtures of the types indicated on the fixture schedule and they shall be furnished as outlined hereunder.

B. Basic catalog number only is given herein for fixtures; plaster rings, fixture ends or caps, suspension units, furnish mounting brackets and/or all other auxiliary parts necessary for a complete installation. Fixture shall be furnished as required, for a full and complete installation, even though not specifically called out on plans.

C. Should any parts of the fixtures be found to be bent or not in accord with their designed position, adjust, repair or replace at once the affected items required.

2.03 FIXTURE LAMPS

A. All fixtures that are LED will have the LED's included with the fixture.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine each luminaire to determine suitability for lamps specified.

3.02 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on drawings.

3.03 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.04 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.
4. Check and confirm ceiling material, recessing space and suspension system with Construction Manager before releasing the order for any recessed fixtures.
5. Type of ceiling material and suspension system must be submitted with fixture order to ensure delivery of proper fixtures.
6. Approval of fixture drawings by the Electrical Engineer shall not relieve this section from responsibility of ceiling confirmation.

7. Clean electrical parts to remove conductive and deleterious materials.
8. Remove dirt and debris from enclosure.
9. Clean photometric control surfaces as recommended by manufacturer.
10. Clean finishes and replace damaged equipment.
11. All fixtures to be supported from structural system, not from ceiling material.
    a. All fixtures to be supported at minimum of 4 feet-0 inches on center.
    b. All tees supporting fixtures to be secured directly to the structural system.
    c. Intermediate tees shall not be used for mounting fixtures.
    d. If fixtures occur between structural tees, fixture supports shall be installed by spanning structural tees from above, or by suspending a channel support above ceiling from building structure.
12. Recessed lay-in and non-recessed grid mounted lighting fixtures:
    a. Where lay-in light fixtures are provided, the fixture shall be securely fastened to the ceiling framing members by mechanical means; such as bolts, screws, or rivet clips identified for use with the type of ceiling framing members and fixtures being used.
    b. Grid mounted fixtures shall be mounted in the grid and attached to the grid system per NEC.
    c. Separate mounting shall be provided to the ceiling structure above.
    d. Provide a minimum of two supports per fixture per NEC.
13. Pendant suspended luminaires:
    a. All stem mounted luminaires shall be suspended with swivel hangers.
    b. Install suspended luminaires using pendants/stems supported from swivel hangers.
    c. Provide pendant/stem length required to suspend luminaire at indicated height.
14. Aircraft cable suspended luminaires
    a. All aircraft cable luminaires to be suspended with swivel hangers.
    b. Install aircraft cable suspended luminaires using aircraft cable supported from swivel hangers.
    c. Provide aircraft cable length required to suspend luminaire at indicated height.
15. Recessed luminaries:
    a. Locate recessed ceiling luminaires as indicated on ceiling plan.
    b. Relocate light fixtures as necessary and coordinate with other mechanical trades.
    c. Coordinate installation in the field, where necessary.
    d. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
    e. Install clips to secure recessed grid-supported luminaires in place and separate support wires for each fixture.

f. Where recessed fixtures occur in tile ceiling, notify the ceiling contractor so fixture and tile arrangements can be coordinated.
g. Install recessed luminaires to permit removal from below.

16. Surface mounted luminaries:
    a. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
17. Lighting fixtures installed in areas where there are not suspended ceilings:
    a. In areas where lighting fixtures are installed where there are not suspended ceilings furnish all mounting hardware.
    b. Continuous fixtures:
        1) In areas where lighting fixtures are mounted end-to-end in ceiling joist area, furnish support strut to solidly support the fixtures.
        2) Support strut may be B-line, Kindorf or equal.
        3) Strut shall be supported 8' on center using pendant hangers with swivels mounted on 4" square boxes.
18. Mounting hardware painting:
    a. Mounting hardware to be installed prior to the ceiling being painted.
    b. If it is not installed prior to that time, paint the support hardware.
19. Special color requirements:
    a. Refer to fixture schedule to determine if there are special color requirements for the mounting hardware and lighting fixtures other than the ceiling finish.
20. Clearance heights:
    a. Lighting fixtures shall be mounted to maintain maximum head clearance height and that the bottom of the fixtures shall be even with the bottom of the ceiling joists.
21. Mounting locations:
    a. The fixtures shall be mounted between the joists unless otherwise shown on the floor plans.
    b. If fixtures are mounted perpendicular to joist, attach fixtures to the bottom of the joist and furnish steel support struts to the bottom of the joists for fixture support.
22. Individual fixtures:
    a. In the ceiling joist area, individual fixtures shall be supported using pendant hangers with swivels mounted on 4" square boxes.
    b. Fixtures shall be fed through one pendant end.
23. Flat ceiling spaces:
    a. The fixtures shall be mounted tight to the ceiling unless it is required to adjust the fixture height because of mechanical equipment interference.
    b. If required to adjust the fixture height because of mechanical equipment interference, support the fixtures using pendant hangers.
24. Wire Guards:
    a. Furnish wire guards for all open strip or industrial fixtures.

25. Mechanical Rooms:
    a. The light fixtures in the mechanical rooms are shown to indicate number of fixtures only.
    b. Locate the lighting fixtures to coordinate with the mechanical equipment installation.
    c. If required, these fixtures may be supported using chain with a cord connection.
    d. If fixture cannot be mounted on the ceiling, lighting fixture shall be mounted on the wall using an adjustable wall bracket.

B. Lamps shall be factory installed.

C. Install accessories furnished with each luminaire.

D. Connect luminaires using flexible conduit.

E. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

F. Bond products and metal accessories to branch circuit equipment grounding conductor

G. Fixtures not to be used as a raceway. A fixture may only feed another fixture if it is in master/slave configuration.

H. Installation: High Bay Lighting
    1. It is the intent that all high bay lighting and to be above the structural steel members in the space. If the lighting fixture location shown conflicts with a structural steel member or other mechanical system, the fixture may be shifted from the ceiling pattern shown to compensate. Shift all fixtures in that row. If it is impossible to provide a symmetrical pattern because of interferences from other equipment, coordinate the layout with the Electrical Engineer prior to installation.

I. Cleaning:
    1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
    2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
    3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

J. Final Testing:
    1. Operate each luminaire after installation.
    2. Confirm light controls properly operate intended fixtures.

3.05 OWNER TRAINING

A. Provide minimum of one hour training on luminaire operation and lamp replacement.

END OF SECTION

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SECTION 27 10 00

STRUCTURED CABLING SYSTEM

PART 1 GENERAL

1.01 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.02 APPLICABLE PUBLICATIONS

A. TIA/EIA 568-B.1 – Commercial Building Telecommunications Cabling Standard, Part 1: General requirements.

B. TIA/EIA 568-B.2. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

C. TIA/EIA 568-B.3 Optical Fiber Cabling Components Standard.

D. TIA/EIA-569-A - Commercial Building Standards for Telecommunications Pathways and Spaces.

E. TIA/EIA-606 - Documentation.

F. TIA/EIA-607 - Commercial Building Bonding and Grounding Requirements.

G. IEEE 802.3an-2006 Physical Layer and Management Parameters for 10Gb/s Operation, Type 10GBASE-T.

H. Definitions:

1. MDF: Main Distribution Frame - this term is used interchangeably with MC (main closet).
2. IDF: Intermediate Distribution Frame - this term is used interchangeably with TC (telecommunications closet).
3. Access point: The outlet point for wireless LAN connection.
4. Backboard (normally called a backplane): A panel, wood or metal, used to mount termination hardware, on the wall that is adjacent to the relay rack. The plywood used for the backboard shall be fire rated ¾” plywood, painted off white.
5. Backbone Cable: A facility installed between different distribution points for the purpose of connecting system distribution points.
6. Back/Outlet Box: This box is used for terminating outlets.
7. Cable Labeling System: The printed labeling system that allows labeling of each telecommunications room (TR), all relay racks, patch panels, backbone and horizontal cables (this includes the grounding bus throughout the facility) and conduit runs.

8. Cable Tray: A mechanism that allows cable to be managed.
9. Communications Pole (also called Power Pole): A raceway that provides a patch from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services.
10. Conduit Run: Multiple sections of conduit placed to run cables inside. Typically a conduit run is when you cannot see the other end from the beginning.
11. Conduit Stub: A section of conduit place to run cables up (vertically) to an exposed cable route in the ceiling area. The conduit stubs sometimes run down through the floor to the ceiling area below or to a floor jack.
12. Contractor, Electrical (EC): The contractor that is awarded the bid or contract for described work in Division 26.
13. Cross-Connect: A facility enabling termination of cables and their inter-connection.
14. Cut-In: Creating a pathway, using the wall cavity as the pathway. Used when there is no conduit in place and raceway is not required vertically up the wall.
15. Exposed: This is any location that can be seen from an occupied space when the project is complete. The exceptions will be noted in this specification.
16. Entrance Facility: This area provides the entrance point for the communication services that enter the facility from the AP or the cable service provider. Lightning protection shall be installed, unless otherwise noted. This is where the outside cable type shall convert to inside cabling, unless otherwise noted. The outside cabling can be extended to the equipment room in metal conduit. It is recommended, however not required, that the lightning protection be installed as soon as the cable enters the building. The entrance facility may be shared with other services. The lightning protection shall be grounded to the building main ground (this can be done by attaching to the TMGB).
17. Firestop: Specialty material to re-establish a fire rated barrier. The material used is either cementitious or elastomeric.
18. Ground Busbar: The bar that is installed to attach the grounding conductors to. The one that is attached to the grounding electrode via a bonding conductor, typically located in the electrical switch room. Then a TBB is attached to the TMGB and allows all of the TGB's to be grounded. The one that is installed in all of the TR's is a telecommunications busbar (TGB).
19. Ground Conductor(s): The conductor that provides ground to the main grounding system, at the electrical panels is called the bonding conductor
20. Horizontal Cabling: The cable used to carry the information from the workstation or end device to the least significant distribution point. For the voice and data this will be the telecommunications room. The paging and security will be where distribution points are; normally this is in the equipment room or telecommunication room or equipment room.

21. Installer: Contractor installing the low voltage structured cabling and associated hardware.
22. J-Box: the boxes used to limit or extend distances within a conduit run or horizontal raceways. This box will be required to have the appropriate blank covers installed. The size is determined by the application and the guidelines in the TIA/EIA cabling standards.
23. J-Hook: A support device that is attached to the building structure and used to support structure cabling. The device is shaped like a J and the cables are laid in the open section of the J. There will be a retainer installed on all j-hooks.
24. Ladder Rack: A similar device to a cable tray, however more open elements. The ladder rack is usually installed where there is a high density of cables and accessibility is higher than normal.
25. Office Furniture: The landscape furniture used in place of fixed wall offices. Sometimes referred to as cubicle furniture.
26. Pathway: A vertical and horizontal path, used to place telecommunication cable inside of it.
27. Plenum: A compartment or chamber that is used as part of the air distribution system and is connected with one or more air ducts. Due to the airflow through this chamber, the cable and other materials used in this chamber are required to have a higher fire rating. Typically this airflow is the return airflow path.
28. Power Pole: A raceway that provides a path from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services. If the access pole is a dedicated pole for communication cables, it is sometimes referred to as a communication pole.
29. Pull Cord/Wire: Cord placed in a cable path to pull wire through that same path.
30. RCDD: Registered Communication Distribution Designer. A certification provided by BICSI to individuals that have met criteria via education and testing to be certified to design telecommunication systems.
31. Service Cable Path: The service cable path is a route that allows a minimum of 10’ of spare cable provided at the distribution point for the purpose of having spare cable for servicing the structure. This cable will be managed by support hardware as designated by the drawings provided. (There shall not be any service cable left at the station end other than the 6” to 10” left after the cable is terminated.)
32. Station Outlet: A device placed at the end of the horizontal cable to terminate the horizontal cable and connect the network equipment in the work area.
33. Telecommunications Contractor (TC): The contractor that is awarded the bid or contract for this work will include all the work as described in this specification, excluding the EC specified work.
34. Telecommunications Utility: The telecommunications utility will bring their services into the equipment room as designated on the floor plans.

35. Testing: Qualifying the cable for the necessary parameters described. The testing requires electronic and hardcopy of the test results. Sometimes referred to as Acceptance Testing.
36. Utility Pole: A raceway that provides a path from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services.
37. Work Area Outlet: A device placed at the end of the horizontal cable to terminate the horizontal cable and connect the network equipment in the work area.

1.03 DESCRIPTION OF WORK

A. Furnish and install a complete and operable data cabling system as indicated on the drawings and as specified herein.

B. Mount and connect owner furnished WAPs in new locations as indicated on plans as "WAP". Furnish and install data cables to this location and coil 25' service loop at structure supported with D ring. Mounting hardware to be supplied by owner. Assume all data outlets shown with WAP on drawings will require a WAP to be mounted. Coordinate with District which locations will have WAPs installed and which locations will be for future WAPs. In rooms with multiple WAPs shown, but only 1 installed, extend cabling to center of room (utilizing service loop) to mount WAP (typical of most classrooms). Field verify locations of WAPs with District Technology Department in rooms which will have more than 1 WAP mounted. Provide male end on all WAP device outlets shown at WAP location and terminate end in data closet on standard patch panel. Coordinate WAP IP addresses prior to installation with district.

C. Division 27 Contractor to coordinate with Division 26 Contractor to determine where each party's work leaves off.

D. The Division 27 Contractor to furnish special backboxes, make final connections and perform supervision to ensure quality, accurate work. Provide necessary information to other divisions for power requirements and rough-in information.

E. Furnish and install all head-end equipment and all field equipment. Furnish and install all low voltage cabling required for a complete and operating system.

F. The Division 26 Contractor to furnish and install standard backboxes and install special backboxes. Furnish and install conduit, fittings, and junction boxes. Provide 120 volt connections to equipment indicated on drawings and in the specification. Provide conduit stubs through walls to head-end to all field equipment.

G. Division 26 contractor to include all division 27 work in his bid.

1.04 RELATED WORK ELSEWHERE

A. Division 26 and 27 – Electrical.

1.05 SHOP DRAWINGS

A. Submit shop drawings.

B. The following information shall be submitted in addition to items listed above:
   1. Wiring diagram indicating wire size and type for each individual piece of equipment.
   2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
   3. Complete front elevation drawing of equipment rack and exact component layout within rack.
   4. All drawings must be in CADD format.
   5. Cable listing for each cable installed. Indicate in spreadsheet format showing room location, head-end location, and exact labeling. Provide on each end of each outlet.
   6. Reduced size floor plan drawing (11" x 17"), showing building floor plan and location of all data outlets. Each of the rooms shall be numbered and the approximate location of each data outlet shall be shown. Prior to beginning that, determine if the owner has an existing number plan sequence in place, and if so, he shall use that numbering system for this project. Include such numbering system on his submittal data.
      a. Determine the numbering method for each of the outlets. As an example; a typical space which consists of five data outlets, the suggested format is to assign a cable number (1, 2, 3, 4, etc.) for each of the data outlets or a letter (A, B, C, D, etc.).
   7. As a part of the shop drawing documentation, cable numbers, data outlet numbers, and patch panel jack numbers must be assigned and shown.

1.06 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manual.

B. The following information shall be submitted in addition to the items listed above:
   1. Wiring diagram indicating wire size and type for each individual piece of equipment.
   2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
   3. Complete front elevation drawing of equipment rack and exact component layout within rack.
   4. Provide copy of written warranty.

1.07 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Division 01.

B. Ensure all cables are less than 300 feet in length. Install cables in the shortest possible manner to ensure less than 300 feet is maintained.

C. A single contractor, who has at least five (5) year experience in furnishing similar data, voice, and video systems, shall supply all specified equipment and services.

D. Contractor shall employ a project manager for this project who has completed five (5) projects (similar in size) in the last 5 years and holds an active RCDD status. Credentials shall be available to the Engineer upon request.

1.08 WARRANTY

A. The data cabling system and labor for installation shall be provided with a minimum 20-year warranty from the cable manufacturer. This warranty shall cover material and workmanship.

B. The cable installed shall be a certified integrator, and shall provide cable manufacturer certified outlet components, such that the entire system is certified for the 20-year warranty. Provide a letter of verification as a part of the submittal drawings indicating that the warranty will be provided. Failure to provide this letter will cause submittal to be rejected and will require resubmittal.

C. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

D. Submit a written warranty executed by the installer agreeing to repair or replace any data or phone cabling that fails within the warranty period.

E. During the guarantee period there shall be no charges to the Owner for service calls for guarantee work. However, when service work is required to repair items damaged by neglect, misuse, or vandalism, costs shall be reimbursed to this Contractor.

F. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

A. POE switches:
   1. Owner to furnish and install POE and POE+ switches

2.02 UTP DATA CABLE

A. All data and voice outlet cabling shall be:
   1. Category 6 type
   2. Sheath rated.

3. Plenum rated.
4. Data cable color shall be:
   a. Blue
5. Approved manufacturers:
   a. Amp.
   b. Belden.
   c. Berk-Tec.
   d. Comm Scope.
   e. Mohawk.
   f. Superior Essex.
   g. General Cable
   h. West Penn

B. Cable shall meet the following requirements

Frequency	Power Sum Attenuation (Max) dB/100m	Power Sum Near End Cross Talk (min)	Power Sum ACR
1 MHz	2.0 dB	76 dB	72
4 MH	3.8 dB	67 dB	60
10 MHz	6.0 dB	61 dB	52
20 MHz	8.5 dB	56 dB	46
100 MHz	19.8 dB	46 dB	32
200 MHz	29.0 dB	42 dB	26
250 MHz	32.8 dB	40 dB	24
350 MHz	39.8 dB	38 dB	21
400 MHz	43.0 dB	37 dB	20
500 MHz	48.9 dB	36 dB	18

2.03 WORKSTATION COMMUNICATION OUTLETS - WALL MOUNTED

A. See floor plans for communication connector types to be included at each workstation communication outlet location.

B. Each communication outlet shall consist of:
   1. 4" square, 2 1/8" deep outlet box.
   2. Single gang ring.
   3. 1" conduit minimum stubbed into ceiling space, either stubbed into room, or if cable tray is provided, stubbed toward cable tray. If cable tray is not provided, stub toward corridor. Provide insulated connector on each end. Size conduit for quantity of cables shown.
   4. Communication outlet plate angled type to allow for Cat6 cabling bending radius.
   5. In those areas where devices are mounted on existing walls, provide an equivalent surface raceway system. Use Wiremold or Hubbell deep outlet box and surface metallic raceway.

C. Provide wall mount face plates, combination type. Face plate to include the following:
1. Nylon, lexan type. Color: to match wiring devices. Angled type.
2. 4-position openings for keystone type outlets; if more than 4 devices are shown at a location, provide 6-position openings for keystone type outlets.
3. Label holders.
4. Typed overlay label affixed above each outlet position indicating the outlet number.
5. All empty openings shall be closed.
6. Provide the appropriate communications device in the opening as shown on the floor plans.

D. Data outlets 568B, RJ45 configuration, angled-type.
1. Data jack color shall be:
a. Blue
2. Data outlets shall be power sum rated.
3. Outlets shall meet the following minimum requirements:
a. Power sum next @ 100 Mhz = 40 dB.
b. Next @ 100 Mhz = 42 dB.
c. Attenuation @ 100 Mhz = .4 dB.
d. Return loss @ 100 Mhz = 18 dB.

E. Wall phone mounting plates:
1. Stainless steel with two mounting studs.
2. 8-position 110 IDC.

2.04 DATA JUMPER CABLES

A. Provide (1) 24" category 6 jumper cable for each data outlet, Keyless entry and WAP shown on power plans for the District’s use for connecting between patch panel and switches. Color to match cabling color listed.

2.05 PATCH PANELS CATEGORY 6

A. Patch panel shall be as follows. All patch panels shall be power sum rated and tested in a link configuration. Devices shall have same rating as station outlets.
1. Category 6.
2. 48 jack high density assembly.
3. Each jack shall have an associated “type-on” label for marking and shall be marked.
4. Each patch panel shall have associated with it, a rear mounted and front mounted metal wire manager unit.
5. Each patch panel shall be identified with an engraved nameplate. Plate shall be designated as: "Data Distribution Patch Panel #1". The next patch panel shall be identified as "Patch Panel #2". etc. For projects where there are more than 1 network rack, each rack shall be further identified with a label indicating that it is Data Network Rack #1, #2, etc.

6. Each patch panel rack/enclosure shall have vertical wire management on both sides.

2.06 DATA EQUIPMENT LABELS

A. See specification section 26 05 53 for label materials.

2.07 PLYWOOD BACKBOARD

A. Provide 4 x 8 fire resistant painted plywood, AC grade, good one side, where shown on walls. Paint plywood white with fireproof paint. Provide cutout for flush receptacles. Furnish and install extension rings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.02 DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.03 INSTALLATION

A. All voice and data jacks to be labeled at device location and origination within 6" of end of cable.

B. Provide complete testing and documentation as listed in Operation & Maintenance Manuals.

C. General:
1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received from Architect stating that these conditions exist at building site.

D. Cleaning:
1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

E. Raceways:
1. All 120 volt wiring shall be in a conduit system separate from other building wiring.
2. All 120 volt wiring shall be in minimum ¾” steel raceway. Below floors to be rigid steel conduit.
3. There shall be no sharp edges with installed materials.

F. Cable:
1. Cable type, size, and quantity to be as shown on drawings. Vendor to verify exact cable required based on the equipment and provide appropriate cable.
2. All wire runs shall be continuous lengths, without splices.
3. All wiring systems shall be color coded as shown on the drawings. Green conductors shall be used only for grounding conductors, white only for neutral conductors and black shall be reserved for 120-volt line.
4. Marker strips shall be attached to the field wiring. These markers shall not change when devices are replaced during repair or maintenance.
5. Within equipment cabinets, all wires and cables shall be contained in wire management channels such as Panduit or equal, and dressed and labeled in such a manner that all wires may be easily traced, and such that they do not obstruct access to components which may need to be replaced or serviced.
6. All low voltage cabling to be routed in “D” rings or in cable tray.

G. Final Testing:
1. The completed data system shall be fully tested by the Contractor. Upon completion of a successful test, certify in writing to the Owner.

H. Conduit stubs: The plan notes indicate, in a number of locations, the appropriate termination point for conduit stubs. In areas where ceilings are unfinished or ceilings are inaccessible by either height or for other reasons, the conduit stubs shall be extended to a further location to an accessible area. Lay out conduit runs such that all data installation runs are 300' or less.

I. Numbering and labeling:
   1. All communication outlets shall be provided with an overlay label indicating the outlet number. This shall be provided for all devices mounted in the communications faceplate.

J. Data and Voice cables – UTP:
   1. Shall be installed in raceways and cable trays where applicable.
   2. Where cable is run in the open, it shall meet the following criteria:
      a. Routed through "j-hook" or "D-ring" system.
      b. Maintain at least a 12" separation from fluorescent or neon lighting fixtures.
      c. Maintain at least a 3.3' separation from transformers, motor or other sources of electromagnetic fields.
      d. Maintain the following separation from unshielded power cables - 36".
      e. Maintain separation from under cabinet fluorescent fixtures installed on modular furniture.
      f. Do not route within 50' of arc welders.

K. Cable Termination:
   1. All cable conductors shall be terminated per EIA/TIA cable terminating standards as recommended by the manufacturer of the data system.

L. Cable Support & Raceways:
   1. In areas where cable trays are provided, cables shall be installed within the trays. Extend cables from trays to conduit stubs down to outlets.
   2. In areas where there are not accessible ceilings, cables shall be installed in surface mounted, non-metallic or metallic raceway as specified in specification section 26 0534. Provide all ceiling raceways where multiple cables are run with a minimum of 50% additional space to allow for future cables to be added. If surface raceway size is shown on drawings, provide that size or larger or multiples of the size shown as required.
   3. Above accessible ceilings, a "J-hook" support system shall be used throughout the ceiling space, tunnel space, mezzanines, and other areas where cables are run. The "J" shall have flat bottom to eliminate single point stress on cables supported. Cables shall not be installed in a hap-hazard manner across the ceiling grid system. The following method shall be used:
      a. Conduits that are stubbed into the accessible ceiling space that are acting as cable raceways shall be extended into the nearest corridor space, or, as an option, install a sleeve through any wall separating the room from the corridor area.

b. Cables shall be routed at 90 degrees from the room to the J-hook support system in the corridor. The corridor area shall generally be defined as the area where the J-hook support system shall be installed. However, in the event that there is not adequate corridor space, the J-hook system may be moved into the adjacent rooms.

c. J-hook system shall be installed in straight lines perpendicular, right angle to the building walls. Groups of J-hooks shall be used where the single J-hook system is not adequate to support the cabling.

d. The support system shall be used up to the conduits that feed the cables into the outlet or cable distribution points. Mark the record drawings to indicate the approximate path of the support system.

e. Mark the "record drawings" to indicate the approximate path of the J-hook system.

4. Maximum spacing between J-hooks is to be 3'.

M. Provide and install all wall sleeves and penetrations. Any place that a wall is penetrated to route cable through the wall, the contractor shall provide a through-the-wall sleeve. This may be PVC conduit in those areas where plenum cable is not used. It shall be steel conduit with insulated connectors on ends in those areas where plenum ceilings are used. Assume that for each door entering each room, to include in pricing, the cost of providing and installing one sleeve above all doors entering rooms. These sleeves shall be installed above the ceiling grid.

N. In those areas where there is not a ceiling, all system cables shall be routed through conduit, through the non-ceiling area, into an area where there is ceiling cavity. There shall be no open cables routed through ceiling areas, unless it is indicated otherwise on the drawings.

O. Cable Labeling Scheme:

1. The Owner has implemented an existing data cabling and patchpanel outlet labeling scheme which the contractor will be required to follow for this project.

2. The scheme labels the cable and outlet numbers based on the telecommunications closet location, patchpanel location within that rack, and the outlet number on that patchpanel. The contractor will be required to meet with the owner’s telecommunications facility coordinator prior to providing data cabling. For this project the contractor will be required to determine that prior to equipment and cable listing submittal, and from that information, provide the appropriate label numbers on the submittal documents. This submittal will be required prior to installation.

P. Installation Of Cabling In Existing Facilities:

1. The following shall be the criteria for the installation of low voltage systems in existing facilities:

a. All cable shall be run concealed. This shall be:

1) Above grid ceilings where grid ceilings or other ceiling structures are available. See description above for installation in ring support system or tray.
2) In raceway; in open ceiling spaces such as mechanical rooms, shops, storage facilities.
3) In surface raceway; in finished spaces, such as; classrooms, offices, corridors and hallways.
4) Provide surface raceway with accompanying surface boxes on ceilings and walls.

b. Provide and install wall sleeves and penetrations. Any place that a masonry wall is penetrated to route cable through the wall, provide a through-the-wall sleeve. It shall be steel conduit with insulated connectors on the end in those areas where plenum cable is used.

c. In those areas where through-the-floor or through-the-ceiling, or through-corridor raceways are indicated, assume the following:
1) Steel raceways shall be terminated with insulated bushings or connectors.
2) Where raceways are run through masonary walls, the hole through the wall shall be patched tight around the raceway using grout.
3) Where raceways are run through existing open ceiling areas, such as stairwells, the raceway shall be installed tight to the ceiling and run parallel or perpendicular to the existing wall/ceiling angles.

d. Installation of devices in existing spaces:
1) Move and reinstall any bookcases, desks, tables, chairs, or any other Owner's equipment that is in place that requires relocation to allow the installation of the new equipment. This should be worked out with the owner in advance of installation. Coordinate work times with owner or building tenant in occupied spaces.

e. Installation of patchpanels in existing racks:
1) New patchpanels shall be installed in existing racks. Relocate any equipment that is presently in the rack to accommodate the patchpanels such that the new patchpanels are adjacent to the existing cable patchpanels. Relocate existing electronic equipment.

Q. Patch Panel Installation:
1. Patch panels shall be installed and connected such that the incoming cables are grouped by rooms, spaces, and departments. It will be the contractor or his supplier's responsibility to initially meet with the Owner to determine what the requested groupings are.

2. The submittal drawings for the data system shall include front elevations of all patch panels should be shown with a number that will be associated with each patch panel jack. See system documentation for additional requirements. There shall be a listing indicating which jack is connected to which outlet; i.e. room space or department.
3. Incoming cables to patch panels shall be neatly trained and attached via cross-frame members or other method to hold cables independent of patch panel jacks.

3.04 OWNER TRAINING (NONE)

3.05 SPARE EQUIPMENT (NONE)

END OF SECTION